FIELD GUIDE TO FOREST ECOSYSTEMS OF WEST-CENTRAL ALBERTA

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FIELD GUIDE TO FOREST ECOSYSTEMS OF WEST-CENTRAL ALBERTA

I.G.W. Corns and R.M. Annas[1]

NORTHERN FORESTRY CENTRE
CANADIAN FORESTRY SERVICE
1986

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[1] Wildlife Management Division, Department of Renewable Resources, Government of the Northwest Territories, Yellowknife, NWT X1A 2L9

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ABSTRACT

A forest-ecosystem classification for a west-central Alberta study area was designed using vegetation, soil, and forest-productivity information to describe 30 ecosystem associations. Management interpretations were made for harvest season and method; site preparation intensity; soil compaction, puddling, and erosion; reforestation species, method, and limitations; frost heave; type and severity of vegetational competition; windthrow; snowshoe hare damage; and potential site productivity in site index and mean annual increment. Color photos and drawings are presented for 80 common forest plants.

RESUME

Une classification d'écosystèmes forestiers pour une zone d'étude du centre-ouest de l'Alberta a été conçue à partir de données sur la végétation, les sols et la productivité forestière afin de décrire 30 associations. Des interprétations touchant l'aménagement ont été faites pour la saison et la méthode de récolte; l'intensité de la préparation du terrain; le compactage, le tassement par l'eau et l'érosion du sol; les espèces et la méthode employées pour le reboisement ainsi que les limites de celui-ci; le déchaussement par le gel; le type de concurrence végétale et son intensité; les chablis; les dommages causés par les lièvres; et la productivité potentielle des stations exprimée par l'indice de station et l'accroissement annuel moyen. Des dessins et des photos en couleur représentant 80 plantes forestières communes sont présentés.

FOREWORD

The authors wish to express their appreciation to the following people, whose help and cooperation made this guide possible: G. Barth of the Northern Forestry Centre's Saskatchewan District Office, Prince Albert, for drawings of the plants and landscapes; P. Behman and H. Habgood, formerly of the Alberta Forest Service, for assistance in the field, data analysis, and report preparation; S. Robertson, H. Archibald, and the Resource Inventory Section of the Resource Evaluation and Planning Division, Alberta Energy and Natural Resources, for helpful discussion on correlation and for assistance with data analysis; foresters in the Alberta Forest Service and in industry, who provided much of the input for the interpretations of the classification data and comments on preliminary drafts of the guide; and J. Hiley of the Agriculture Canada Soil Survey unit and K. Toogood of Alberta Agriculture, who prepared the computerized interpretive maps. Dr. G. LaRoi (University of Alberta), Dr. J. Pojar (B.C. Ministry of Forests), Dr. J.G. Packer (University of Alberta), L. Jang (B.C. Ministry of Forests), and Resource Evaluation and Planning Division staff of Alberta Energy and Natural Resources reviewed the plant identification component of this guide. Our appreciation is also expressed to D. Allan and B. Hamman for drafting the figures and for data analysis.

HOW TO USE THIS FIELD GUIDE

1. Using the map in the back pocket, determine the appropriate ecoregion.

2. Do a quick reconnaissance of the area, noting the topography and position on the landscape.

3. Choose a location that appears to be representative of most of the area to be classified.

4. Determine the plant species composition (referring to the plant guide on pages 127-209) and the soil properties (using the guidelines on pages 10-18 and soil survey reports, if available).

5. *For undisturbed sites:* Consult the key to the major ecosystem associations on pages 38-43 to determine the most likely association.

   Check the selected detailed ecosystem association description on pages 45-125 to confirm your choice.

   Forest management interpretations are provided for each ecosystem association.

6. *For disturbed sites:* When ecosystem association identification is difficult, first read the explanatory sections on pages 6-31. If necessary, before leaving the office determine the soil unit/association from the appropriate reconnaissance soil survey map and consult the appropriate soil survey report. Table 6 (pages 34-37) provides forest management interpretations for each unit/association.

7. For the rationale behind the forest management interpretations consult pages 211-230 and supplement these with personal experience. Remember, these are the authors' interpretations and are not prescriptions.

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NOTE

The exclusion of certain manufactured products does not necessarily imply disapproval nor does the mention of other products necessarily imply endorsement by the Canadian Forestry Service.

INTRODUCTION

Prior to 1950, there was little need for management aimed at the production of timber products from forest land in Alberta. As the demand for forest land and products grew the attitudes and policies of government and industry changed. Multiple use and sustained yield forest management practices were implemented upon the establishment of the Alberta Forest Service in 1953. Implicit in their implementation was the need for a detailed and fundamental knowledge of the land base. This, in part, has been realized by the application of a forest land classification to forest management problems. This field guide represents a further refinement in the process, synthesizing recent vegetation and soils information for a west-central Alberta study area and illustrating its use as a framework for some forest management interpretations. An important feature is the inclusion of a guide to the common plants of the study area.

The information presented in this guide is subject to change and improvement as new data concerning forest ecosystems and their measured response to various management prescriptions come available. It is anticipated that an updated edition of this guide will be published after field testing and evaluation by operational foresters in Alberta. A supplementary document containing background information on the study area is available from the authors.

The field guide has two main objectives:

1. to classify and describe ecoregions (ecological zones) and their component ecosystems within the west-central Alberta study area (Fig. 1) with respect to their floristic composition, environmental characteristics, successional relationships, and forest productivity; and

2. to provide a framework for forest management interpretations for the described units. All relevant sources of vegetation, soils, and climate information available at the date of preparation of the guide were consulted, and if possible, incorporated into the guide.

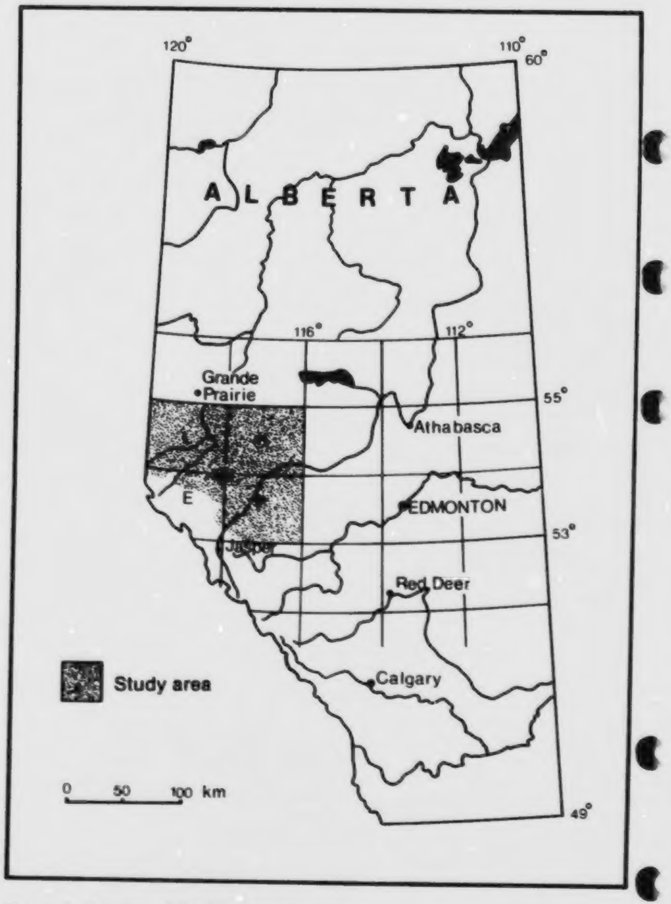
120°
110°
60°
ALBERTA
116°
112°
Grande Prairie
55°
Athabasca
E
EDMONTON
53°
Jasper
Red Deer
Calgary
Study area
0
50
100 km
49°

Figure 1. Location of the Alberta study area.

PROCEDURES

Plot Sampling and Classification

Data were obtained and pooled from approximately 900 sample plots from studies by Corns (1978, 1983), Krumlik et al. (1978, 1979, 1982), Lesko and Lindsay (1973), and Nemeth et al. (1981). Although the work of Lesko and Lindsay (1973) is from the Chip Lake Map Area adjacent to the southeast corner of the study area, many of the sample plots are similar to the lower elevations of the study area farther north and are included in corresponding plot groupings for the study area to provide additional replication.

The 0.01- to 0.04-ha sample plots were selected using forest cover maps and aerial photographs within well-developed, homogeneous forest stands on a variety of soils and landforms. In all the studies, the sample plots were placed subjectively to best represent soil and vegetation conditions. Plot location and general physiography (elevation, slope gradient and aspect, topographic position, relief shape, and landform) were recorded on field sheets. Soils were described according to the Canadian System of Soil Classification (Canada Soil Survey Committee 1978). Vegetation was sampled in a manner compatible with Braun-Blanquet's (1932) methods or those described by Walmsley et al. (1980). Data from all studies were computer coded to facilitate comparison. Classification in the present study was done by tabular comparison (Mueller-Dombois and Ellenberg 1974) using computer-generated vegetation and environment tables. Additionally, all sample plots included forest mensurational data. Site index was determined for all plots based on dominant and codominant trees, and for most plots the stand volumes and mean annual increment in total volume (MAI) were also determined.

Ecoregion Mapping

During the 1982 field season, a ground and aerial reconnaissance was carried out by using fixed-wing and helicopter flights and by driving the major roads of the study area. Preliminary ecoregion boundaries were noted on 1:250 000 maps. Additional ground surveys were carried out during 1983, and ecoregion boundaries were placed on 1:250 000 maps from helicopter traverses of the study area. Although the ecoregions grade slowly into each other over a distance of several kilometres, especially in eastern parts of the study area, the different Boreal ecoregions could usually be separated from the air on the basis of canopy cover of tree species in upland sites; however, lodgepole pine is so pervasive (often to the exclusion of other tree species in the canopy) in the Upper Boreal Cordilleran (UBC) and Subalpine (SA) ecoregions that determining the UBC/SA boundary from the air is extremely difficult. The SA boundary is based on the general presence or absence of typical subalpine plant species in forest stands. Boundary points were established on the ground, and the boundary was drawn on the map by extrapolation, mainly along elevational lines. Map boundaries were checked and adjusted from interpretation of LANDSAT images.

In some cases, other study boundary lines were used (e.g., from Krumlik et al. (1982) for parts of the Berland Forest Management Area and from Alberta Resource Evaluation and Planning Branch studies in the Coal Branch area south of Hinton). The final mapping scale is 1:500 000.

Large-scale mapping (e.g., 1:10 000 to 1:25 000) of ecosystem associations or complexes is recognized to be a valuable tool for intensive forest management but was beyond the scope and resources of this study.

Classification

The classification is adapted from the biogeoclimatic system developed in British Columbia by Krajina (1965, 1969) and his students and parallels the scheme used by the Canadian Committee on Ecological Land Classification (CCELC), the habitat type of the United States Forest Service (Pfister et al. 1977) and the operational group of the ecosystem classification being developed in Ontario (Jones et al. 1983).

The classification system used in this field guide is based on two types of units: 1) **biogeoclimatic**, or zonal, and 2) **ecosystem**, or site. Biogeoclimatic units are large geographical areas; the smaller ecosystem units are abstract taxonomic classes.

The large **biogeoclimatic**, or zonal, units identify vegetation and soil development patterns resulting from a similar macroclimate. They are described hierarchically in terms of ecoregions, eco-subregions, and their phases.

An **ecoregion** is a geographical area that has a distinctive, mature ecosystem plus specified edaphic variation as a result of a given regional macroclimate. It corresponds to the ecoregion of Strong and Leggat (1981), the forest section of Rowe (1972), and the biogeoclimatic subzone of Krajina (1965), Annas and Coupé (1979), and Pojar (1983). The map in the pocket at the back of the guide shows the distribution of ecoregions in the study area. An **eco-subregion** is a subdivision of an ecoregion that is similarly controlled by macroclimate but exhibits less variability in soils and vegetation. **Phases** of ecoregions and eco-subregions identify extensive areas of ecosystems that are, for topographic or topoedaphic reasons, atypical of the regional climate. An example might be an extensive area of frost pockets in mountainous terrain. The phase is not a formal taxonomic unit but may be identified and mapped for management or descriptive purposes. Ecoregion phases are not described in this report.

The small-scale **ecosystem**, or site, units group together similar sites on the basis of soil, vegetation, and physiographic properties. These are the ecosystem types and the ecosystem associations and their phases.

An **ecosystem type** is an abstract taxonomic class defined as all land areas belonging to the same soil family with the potential of supporting vegetation belonging to the same plant association. An **ecosystem association** is an abstract taxonomic unit above the ecosystem type and within an ecoregion. It is defined as all land areas with the potential of supporting plant communities with similar successional development belonging to the same plant association. More than one soil family may be represented. The ecosystem association resembles the plant association of Braun-Blanquet (1932) and the habitat type of Daubenmire (1952). Individual ecosystem association descriptions are the focus of this field guide (pages 45-125).

Phases of ecosystem associations are recognized in order to facilitate more-precise management interpretations and are distinguished on the basis of differences in slope class, aspect, soil, climate, or some other feature of soil or vegetation. Phases are not formal taxonomic categories. A **facies** is a form of ecosystem association dominated by a given tree species. For example, in the *Picea glauca/Viburnum/Aralia* ecosystem association similar sites may support pure stands of aspen, white spruce, paper birch, or pine, depending upon stand origin. Thus the ecosystem association above has four different facies according to the dominant tree species. A **biogeocoenose** is the smallest ecosystem recognized in the field in terms of this classification; its size is determined by the extent of the plant community and the associated soil polypedon.

Units described in this guide are the ecoregion, ecosystem association, and in a few cases the ecosystem association phases.

ECOREGIONS

The forest vegetation of the study area lies within five ecoregions. Nonforested alpine tundra also occurs along the southwestern boundary. The occurrence of the ecoregions is illustrated in a 1:500 000 map in the pocket at the back of the guide. The relative topography of the ecoregions is shown in Figure 2. The correspondence of the ecoregions used in this report with those described in other small-scale ecological zonation studies for the study area is discussed elsewhere in this report. Criteria used to establish ecoregion boundaries are given in Table 1. Plant nomenclature follows Moss (1983).

The following descriptions of each ecoregion are supplemented with moisture and nutrient regime grids (see Tables 2 and 3 for definitions) and cross sections that outline the characteristic tree species and soil parent materials (see Figure 3 for tree symbol explanations and Tables 4 and 5 for mineral soil and humus horizon definitions). Aids to describing soil texture and drainage are found in Figures 4 to 6. The soil names are explained in the Canada Soil Survey Committee (1978) manual.

The moisture/nutrient grid, adapted from the edatopic grid of Krajina (1969), shows the relative modal moisture and nutrient statuses of the ecoregions and ecosystem associations. The descriptions of moisture and nutrient regimes are adapted from Walmsley et al. (1980).

The ecological moisture regime (hygrotope) indicates the relative moisture available for plant growth on the basis of the whole growing season rather than any particular time. The ecological moisture regime is influenced by a variety of factors, the most important of which are shown in Table 2. The ecological moisture regime is generally assessed using site factors (especially soil drainage) in conjunction with the presence of characteristic species in the ecosystem association, although it can be classified using either site or vegetation attributes.

The soil nutrient regime (trophotope) indicates the relative available nutrient supply for plant growth (with emphasis on soil rooting zone pH and exchangeable cations). Because nutrient abundance is not quantified and the relative abundance of individual nutrients is not indicated, use of the trophotope is a problem. The nutrient regime is influenced by a number of factors, including bedrock source, soil texture, organic matter content, humus form, soil reaction (pH), and others (Table 3).

A moisture/elevation ordination (Fig. 7) indicates the common altitudinal ranges of the ecosystem associations, many of which cross ecoregion boundaries, and indicates general relationships among units. A key to the major ecosystem associations appears on pages 38–43.

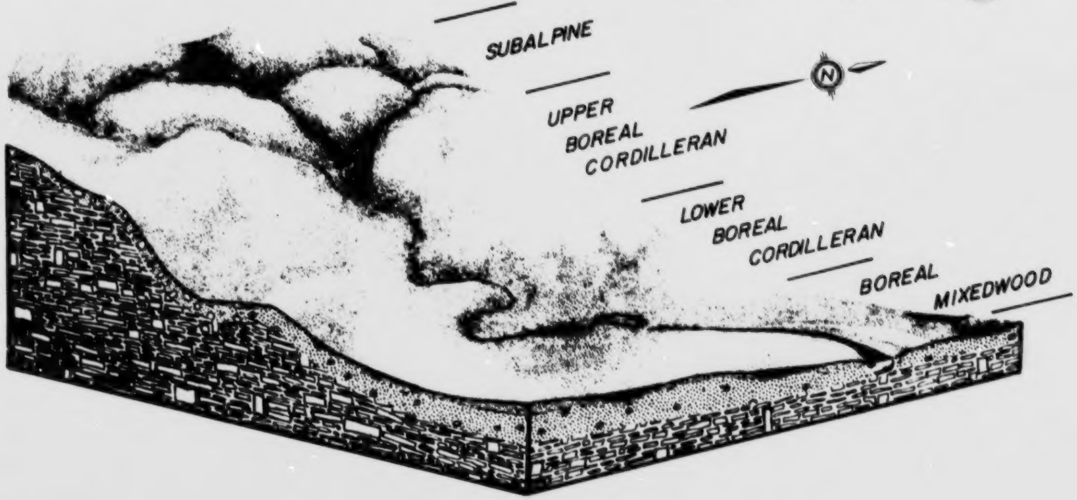
SUBALPINE
UPPER
BOREAL
CORDILLERAN
LOWER
BOREAL
CORDILLERAN
BOREAL
MIXEDWOOD
N

Figure 2. Relative topography of the forested ecoregions of west-central Alberta. Not shown are the Montane Ecoregion (which is of very limited extent in the study area but occurs in proximity to the Lower Boreal Cordilleran Ecoregion) and the nonforested Alpine Tundra Ecoregion (which occurs along the southwestern study area boundary).

Table 1. Criteria used to establish ecoregion boundaries

Ecoregion	Criteria
Boreal Mixedwood (BMW)	Mostly *Populus tremuloides*, *P. balsamifera*, and *Picea glauca* on zonal sites. *Pinus contorta* and *P. banksiana* absent, except on xeric sites. *Vaccinium membranaceum* and *Rubus pedatus* absent.
Lower Boreal Cordilleran (LBC)	*Populus tremuloides* communities dominate zonal sites with mixtures of *Picea glauca* and *Pinus contorta*.
Upper Boreal Cordilleran (UBC)	*Pinus contorta* communities dominate zonal sites with mixtures of *Picea* and *Abies*. *Populus* communities minor or in exposed habitats.
Subalpine (SA)	*Pinus contorta* communities dominate the lower elevations of the zone. *Picea glauca* × *engelmannii* hybrids present. General presence of *Rhododendron albiflorum*, *Menziesia glabella*, *Senecio triangularis*, *Arnica latifolia*. The upper subregion with its characteristic heath vegetation is not distinguished in this study.
Alpine Tundra (AT)	Boundaries obtained from Alberta Resource Evaluation and Planning Branch preliminary biogeoclimatic zone maps.

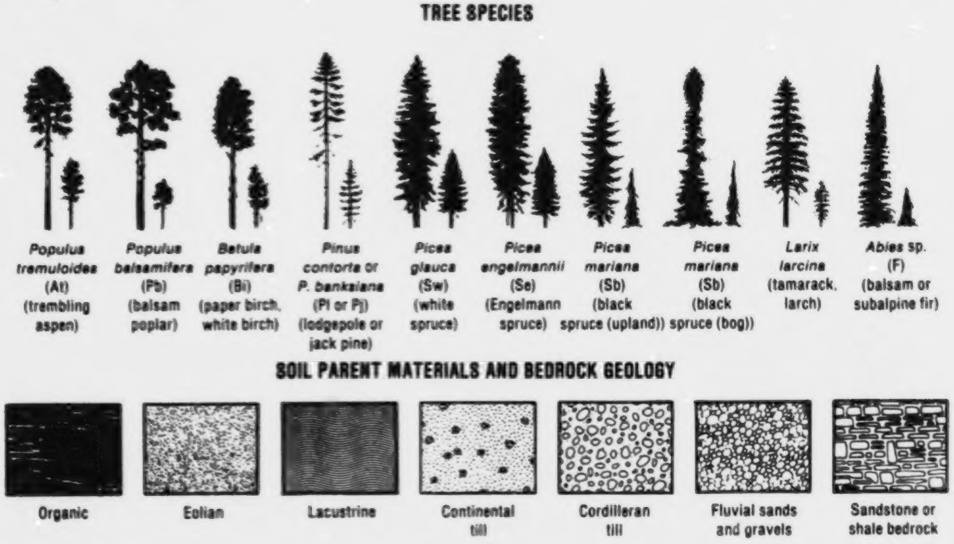
TREE SPECIES
Populus tremuloides (At) (trembling aspen)
Populus balsamifera (Pb) (balsam poplar)
Betula papyrifera (Bi) (paper birch, white birch)
Pinus contorta or P. banksiana (Pl or Pj) (lodgepole or jack pine)
Picea glauca (Sw) (white spruce)
Picea engelmannii (Se) (Engelmann spruce)
Picea mariana (Sb) (black spruce (upland))
Picea mariana (Sb) (black spruce (bog))
Larix larcina (tamarack, larch)
Abies sp. (F) (balsam or subalpine fir)
SOIL PARENT MATERIALS AND BEDROCK GEOLOGY
Organic
Eolian
Lacustrine
Continental till
Cordilleran till
Fluvial sands and gravels
Sandstone or shale bedrock

Figure 3. Key to symbols appearing in the ecosystem association diagrams.

Table 2. Ecological moisture regime classes (after Walmsley et al. 1980)

Moisture regime	Description	Primary water source	Slope position
0 Very xeric	Water removed extremely rapidly in relation to supply; soil is moist for a negligible time after precipitation	Precipitation	Ridge crests shedding
1 Xeric	Water removed very rapidly in relation to supply; soil is moist for brief periods following precipitation	Precipitation	
2 Subxeric	Water removed rapidly in relation to supply; soil is moist for short periods following precipitation	Precipitation	Upper slopes shedding
3 Submesic	Water removed readily in relation to supply; water available for moderately short periods following precipitation	Precipitation	
4 Mesic	Water removed somewhat slowly in relation to supply; soil may remain moist for a significant, but sometimes short period of the year; available soil moisture reflects climatic inputs	Precipitation in moderately to fine-textured soils & limited seepage in coarse-textured soils	Mid-slope normal rolling to flat
5 Subhygric	Water removed slowly enough to keep the soil wet for a significant part of the growing season; some temporary seepage and possibly mottling below 20 cm	Precipitation and seepage	Lower slopes receiving
6 Hygric	Water removed slowly enough to keep the soil wet for most of the growing season; permanent seepage and mottling present; possibly weak gleying	Seepage	
7 Subhydric	Water removed slowly enough to keep the water table at or near the surface for most of the year; gleyed mineral or organic soils; permanent seepage less than 30 cm below the surface	Seepage or permanent water table	Depressions receiving
8 Hydric	Water removed so slowly that the water table is at or above the soil surface all year; gleyed mineral or organic soils	Permanent water table	

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[1] Texture symbols are as follows: L = loam(y), S = sand(y), and Si = silt(y).

Soil properties					
Texture[1]	Drainage	Depth to impermeable layer	Surface humus depth	Available water storage capacity	Slope gradient
Very coarse (gravelly-sand) abundant coarse fragments	Very rapid	Very shallow (<0.5 m)	Very shallow	Extremely low	Very steep, especially on south aspects
	Rapid			Very low	
Coarse to moderately coarse (LS-SL); moderately coarse fragments	Rapid to well	Shallow (<1 m)	Shallow	Low	Steep
Moderate to fine (L-SiL); few coarse fragments	Well to moderately well	Moderately deep (1-2 m)	Moderately deep	Moderate	Moderate
	Moderately well to imperfect	Deep (>2 m)	Deep	High	
Variable depending on seepage	Imperfect to poorly	Variable depending on seepage		Variable depending on seepage	Slight
	Poor to very poorly		Very deep		
Variable depending on seepage	Very poorly	Variable depending on seepage		Variable depending on seepage	Flat

Table 3. Nurtient regime characteristics[1] (after Walmsley et al. 1980)

	A. Oligotrophic	B. Submesotrophic	C. Mesotrophic	D. Permesotrophic	E. Eutrophic	F. Hypereutrophic
Definition	Very poor nutritional status, very small supply of available nutrients	Poor nutritional status, low supply of available nutrients	Medium nutritional status, medium supply of available nutrients	Rich nutritional status, plentiful supply of available nutrients	Very rich nutritional status, abundant supply of nutrients	Saline nutritional status, excess salt accumulations
Bedrock source	Granite Rhyolite Quartzite Quartz sandstone	Granodiorite Dacite Quartz gneiss Conglomerate	Diorite Andesite Garnet schist Graywacke	Gabbro Basalt Biotite schist Argillite Shale	Peridotite Dunite Slate Phyllite Dolomite Limestone	Serpentine Marble Gypsum Halite
Texture	Very coarse	Coarse	Medium	Fine	Very fine	Variable
Organic matter content	Low	Moderate		High		Variable
Humus form	Acid mors	Mors and moders		Moders and mulls		
Soil reaction	Extremely acid to medium acid		Medium acid to neutral	Slightly acid to mildly alkaline		Moderately to strongly alkaline
Cation exchange capacity	Low	Moderate		High		Variable
Base saturation	Low	Moderate		High		Variable
Carbon/nitrogen ratio	High	Moderate		Low		Variable

---

[1] The presence of n[illegible]ent-rich seepage [illegible]ters may compen[illegible] for other factors to create eutrophic conditions.

Table 4. Soil mineral horizon and modifier descriptions[1]

Ah, Ap	Dark-colored, mineral, surface horizons, enriched with organic matter (**p** is man modified, e.g., plow layer)
Ae	Light-colored, near surface horizon; horizon of loss of iron, aluminum, organic matter, or clay
AB	Transition horizon from A to B
Bt	Brownish subsurface horizon, enriched with clay that has been moved from the Ae horizon
Bm	Brownish subsurface horizon with only slight addition of iron, aluminum, or clay
Bf, Bhf	Reddish-brown subsurface horizon; significant accumulation of iron, aluminum, and/or organic matter
Bg	Horizons with grey gley colors, mottling, or both
BC	Transition horizon from B to C
C	Relatively unweathered material from which the soil profile has developed
Ck	C horizon containing calcium and/or magnesium carbonates that will effervesce with dilute HCl
j	Used with suffixes **e, f, g,** and t to denote an expression of but failure to meet the specified limits of the suffix it modifies (e.g., Bfj, Ckgj)
Solum	A and B horizons in which the parent material (C) has been modified

ROMAN NUMERALS:

Roman numeral two (II) preceding the horizon designation indicates a significant change in texture (mode of decomposition) within the profile, e.g., silty loam over coarse sand.

---

[1] For more information on soils description and classification, see Canada Soil Survey Committee (1978), Day (1982), and Walmsley et al. (1980).

Table 5. Forest humus horizons and humus types

L, F, H	Organic horizons developed primarily from the accumulation of leaves, twigs, and woody material with or without a minor component of mosses; usually not saturated for prolonged periods; >17% organic C (approximately 30% organic matter by weight)
L	Characterized by an accumulation of mainly leaves (and needles), twigs, and woody materials; some of the original structures are easily discernible
F	Characterized by an accumulation of partly decomposed organic matter derived mainly from leaves, twigs, and woody materials; some of the original structures difficult to recognize; material may be partly comminuted by soil fauna, as in a moder, or it may be a partly decomposed mat permeated by fungal hyphae, as in mor
H	Characterized by an accumulation of decomposed organic matter in which the original structures are indiscernible; differs from the F by having greater humification chiefly due to the action of organisms; it may be sharply delineated from the mineral soil, as in a mor where humification is chiefly dependent upon fungal activity, or it may be partially incorporated into the mineral soil, as in a moder
Ah	Mineral horizon enriched with organic matter (>17% organic C by weight)
Of, Om, Oh	Organic horizons developed mainly from mosses, rushes, and woody material; >17% organic C (approximately 30% organic matter by weight)
Of (fibric)	The least decomposed organic horizon, containing large amounts of organic fiber (von Post 1–4)
Om (mesic)	An intermediately decomposed soil horizon with properties intermediate of an Of and Oh (von Post 5 and 6)
Oh (humic)	The most decomposed organic horizon, containing only small amounts of well preserved fiber and the major amount of material at an advanced state of decomposition (von Post 7-10)

Continued on next page

Table 5. continued

ADDITIONAL ADJECTIVE DESCRIPTIONS FOR MORS:

F horizons	H horizons
hypno - feather mosses	granulo - granular
sphagno - sphagnum mosses	amorpho - amorphous
licheno - lichen species	mycelio - fungal hyphae mat
ericaceo - ericacaeous roots	rhizo - rootlet network
conifero - conifer needles	
deciduo - deciduous needles	

Boreal Mixedwood Ecoregion (BMW)

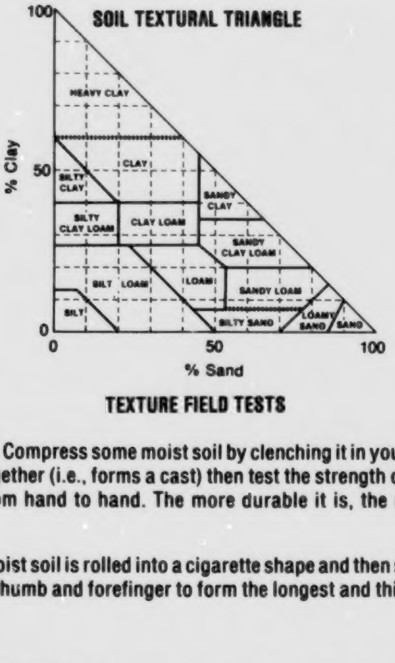
The Boreal Mixedwood Ecoregion is located in the north part of the study area at elevations less than 800 m. Soil parent materials are predominantly glacio-lacustrine. The characteristic forest vegetation on well-drained sites is a mixture of aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*), often with a white spruce (*Picea glauca*) understory. White spruce is more abundant on wetter sites. On dry sites, aspen is predominant. White spruce, sometimes mixed with balsam fir (*Abies balsamea*), is common in older stands. Lodgepole pine (*Pinus contorta* var. *latifolia*) or lodgepole pine—jack pine (*Pinus banksiana*) hybrids are generally restricted to rapidly drained, coarse fluvial, glaciofluvial, or eolian parent materials adjacent to the major rivers or glacial meltwater channels. Foothill outliers of lodgepole pine on mesic sites are, however, sometimes found in the Mixedwood Ecoregion. The ecosystem associations of the Boreal Mixedwood Ecoregion are shown in relation to moisture and nutrient regimes (Fig. 8) and in schematic cross section (Fig. 9).

According to Strong and Leggat (1981), most of the Boreal Mixedwood Ecoregion within the study area belongs to the moist subregion and contains only minor areas of the dry subregion. This field guide refers to only the moist subregion of the Boreal Mixedwood Ecoregion.

Montane Ecoregion

The Montane Ecoregion occurs in a small area west of Hinton, along the Athabasca river valley at elevations of 1040 to 1160 m. Soil parent materials are predominantly highly calcareous eolian deposits overlying Cordilleran till. The characteristic forest vegetation on well-drained sites is dominated by white spruce, and there is aspen on early seral stages. Lodgepole pine occurs very infrequently.

Sample plots were not available for the Montane Ecoregion, so the ecosystem associations of this


SOIL TEXTURAL TRIANGLE
% Clay
100
50
0
% Sand
0
50
100
HEAVY CLAY
CLAY
SILTY CLAY
SANDY CLAY
SILTY CLAY LOAM
CLAY LOAM
SANDY CLAY LOAM
SILT LOAM
LOAM
SANDY LOAM
SILT
SILTY SAND
LOAMY SAND
SAND

TEXTURE FIELD TESTS

Moist cast test: Compress some moist soil by clenching it in your hand. If the soil holds together (i.e., forms a cast) then test the strength of the cast by tossing it from hand to hand. The more durable it is, the more clay is present.

Ribbon test: Moist soil is rolled into a cigarette shape and then squeezed out between the thumb and forefinger to form the longest and thinnest ribbon possible.

Feel test:
GRAININESS TEST—Soil is rubbed between thumb and fingers to assess the % of sand. Sand feels grainy.
DRY FEEL TEST—Soils with >50% sand. Soil is rubbed in the palm of the hand to dry it and to separate and estimate the size of the individual sand particles. The sand particles are then allowed to fall out of the hand and the amount of finer material (silt & clay) remaining is noted.
STICKINESS TEST—Soil is wetted and compressed between the thumb and forefinger. Degree of stickiness is determined by noting how strongly it adheres to the thumb and forefinger upon release of pressure and how much it stretches.

Taste test: A small amount of soil is worked between the front teeth. Sand is distinguished as individual grains which grit sharply against the teeth. Silt particles are identified as a general fine grittiness, but individual grains cannot be identified. Clay particles have no grittiness.

Shine test: A small amount of moderately dry soil is rolled into a ball and rubbed once or twice against a hard, smooth object such as a knife blade or thumb nail. A shine on the ball indicates clay in the soil.

Figure 4. Soil description (after Jones et al. 1983).

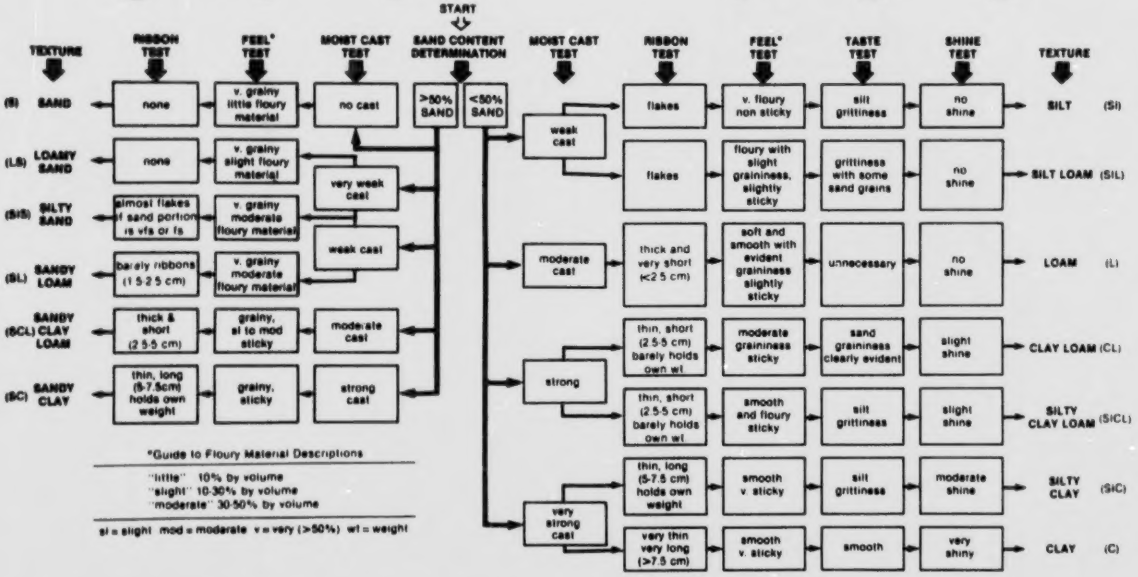
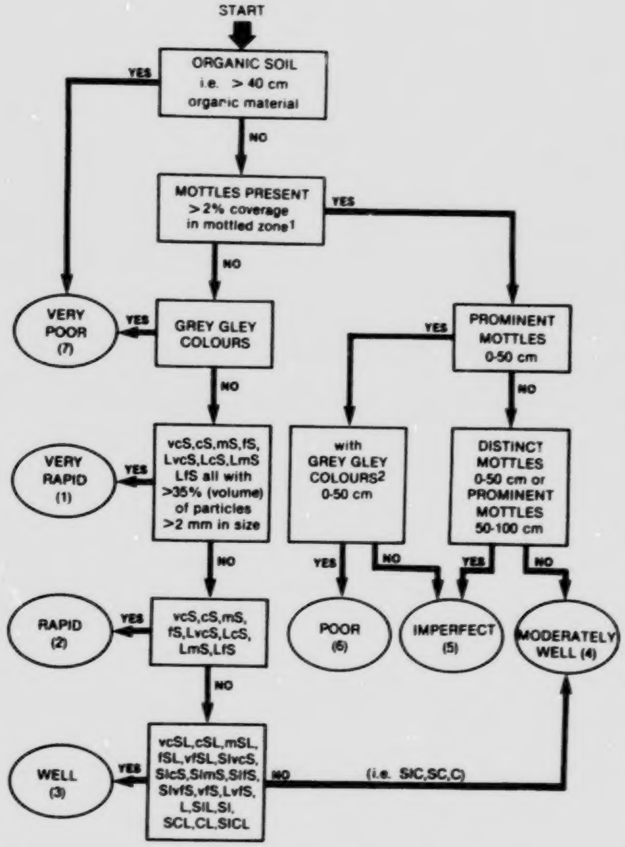

START
SAND CONTENT DETERMINATION
>50% SAND
<50% SAND
TEXTURE
RIBBON TEST
FEEL* TEST
MOIST CAST TEST
(S) SAND
none
v. grainy little floury material
no cast
(LS) LOAMY SAND
none
v. grainy slight floury material
very week cast
(SiS) SILTY SAND
almost flakes if sand portion is vfs or fs
v. grainy moderate floury material
week cast
(SL) SANDY LOAM
barely ribbons (1.5-2.5 cm)
v. grainy moderate floury material
(SCL) SANDY CLAY LOAM
thick & short (2.5-5 cm)
grainy, sl to mod sticky
moderate cast
(SC) SANDY CLAY
thin, long (5-7.5cm) holds own weight
grainy, sticky
strong cast
*Guide to Floury Material Descriptions
"little" 10% by volume
"slight" 10-30% by volume
"moderate" 30-50% by volume
sl = slight mod = moderate v = very (>50%) wt = weight
MOIST CAST TEST
RIBBON TEST
FEEL* TEST
TASTE TEST
SHINE TEST
TEXTURE
weak cast
flakes
v. floury non sticky
silt grittiness
no shine
SILT (Si)
flakes
floury with slight graininess, slightly sticky
grittiness with some sand grains
no shine
SILT LOAM (SiL)
moderate cast
thick and very short (<2.5 cm)
soft and smooth with evident graininess slightly sticky
unnecessary
no shine
LOAM (L)
strong
thin, short (2.5-5 cm) barely holds own wt
moderate graininess sticky
sand graininess clearly evident
slight shine
CLAY LOAM (CL)
thin, short (2.5-5 cm) barely holds own wt
smooth and floury sticky
silt grittiness
slight shine
SILTY CLAY LOAM (SiCL)
very strong cast
thin, long (5-7.5 cm) holds own weight
smooth v. sticky
silt grittiness
moderate shine
SILTY CLAY (SiC)
very thin very long (>7.5 cm)
smooth v. sticky
smooth
very shiny
CLAY (C)

Figure 5. Manual determination of soil texture (Jones et al. 1983).


START
ORGANIC SOIL
i.e. > 40 cm
organic material
YES
NO
MOTTLES PRESENT
> 2% coverage
in mottled zone1
YES
NO
VERY
POOR
(7)
YES
GREY GLEY
COLOURS
NO
PROMINENT
MOTTLES
0-50 cm
YES
NO
VERY
RAPID
(1)
YES
vcS,cS,mS,fS,
LvcS,LcS,LmS
LfS all with
>35% (volume)
of particles
>2 mm in size
with
GREY GLEY
COLOURS2
0-50 cm
DISTINCT
MOTTLES
0-50 cm or
PROMINENT
MOTTLES
50-100 cm
NO
YES
NO
YES
NO
RAPID
(2)
YES
vcS,cS,mS,
fS,LvcS,LcS,
LmS,LfS
POOR
(6)
IMPERFECT
(5)
MODERATELY
WELL (4)
NO
WELL
(3)
YES
vcSL,cSL,mSL,
fSL,vfSL,SIvcS,
SIcS,SImS,SIfS,
SIvfS,vfS,LvfS,
L,SIL,SI,
SCL,CL,SICL
NO
(i.e. SIC,SC,C)

---

1. Exclude mottles that are few or faint
2. Gley Colours
   Chroma 1. any hue
   Chroma 2. hues 10 YR or redder
   Chroma 3. hues yellower than 10YR
   any chroma, hues bluer than 10Y
   any chroma, reddish hues

S = SAND or SANDY
SI = SILT or SILTY
L = LOAM or LOAMY
C = CLAY

vc = very coarse
c = coarse
m = medium
f = fine
vf = very fine

examples:
vcS = very coarse SAND
LvfS = LOAMY very fine SAND
SICL = SILTY CLAY LOAM

Figure 6. Soil drainage (Jones et al. 1983).

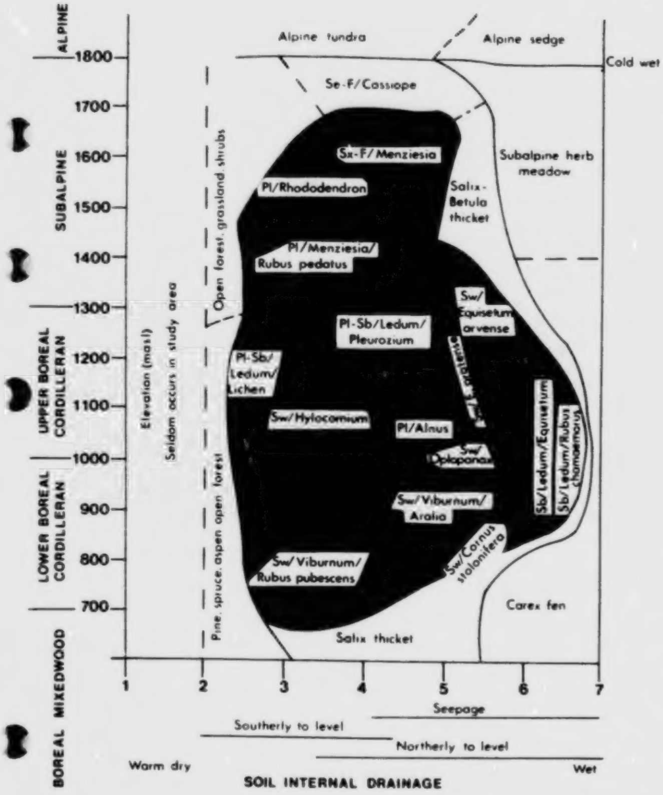

ALPINE
SUBALPINE
UPPER BOREAL CORDILLERAN
LOWER BOREAL CORDILLERAN
BOREAL MIXEDWOOD
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
Elevation (masl)
Seldom occurs in study area
Open forest, grassland, shrubs
Pine, spruce, aspen open forest
Alpine tundra
Alpine sedge
Cold wet
Se-F/Cassiope
Sx-F/Menziesia
Subalpine herb meadow
Pl/Rhododendron
Salix-Betula thicket
Pl/Menziesia/Rubus pedatus
Sw/Equisetum arvense
Pl-Sb/Ledum/Pleurozium
Pl-Sb/Ledum/Lichen
Sw/Hylocomium
Pl/Alnus
Sw/Oplopanax
Sb/Ledum/Equisetum
Sb/Ledum/Rubus chamaemorus
Sw/Viburnum/Aralia
Sw/Viburnum/Rubus pubescens
Sw/Cornus stolonifera
Carex fen
Salix thicket
1
2
3
4
5
6
7
Seepage
Southerly to level
Northerly to level
Warm dry
Wet
SOIL INTERNAL DRAINAGE

Figure 7. Forest ecosystem associations in relation to soil internal drainage and elevation.

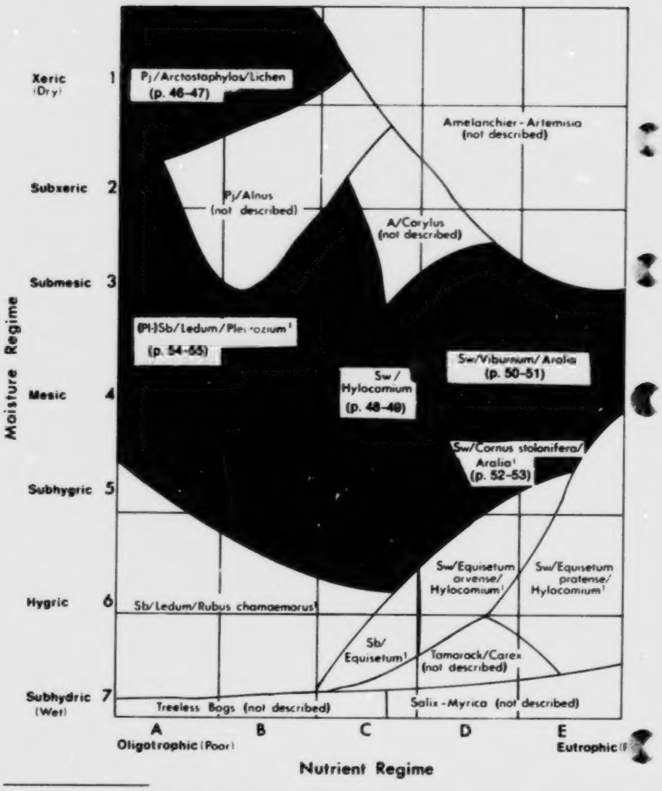

Xeric (Dry)
1
Subxeric
2
Submesic
3
Mesic
4
Subhygric
5
Hygric
6
Subhydric (Wet)
7
Moisture Regime
Pj/Arctostaphylos/Lichen (p. 46-47)
Amelanchier - Artemisia (not described)
Pj/Alnus (not described)
A/Corylus (not described)
(Pl-)Sb/Ledum/Pleurozium¹ (p. 54-55)
Sw/Hylocomium (p. 48-49)
Sw/Viburnum/Aralia (p. 50-51)
Sw/Cornus stolonifera/Aralia¹ (p. 52-53)
Sw/Equisetum arvense/Hylocomium¹
Sw/Equisetum pratense/Hylocomium¹
Sb/Ledum/Rubus chamaemorus¹
Sb/Equisetum¹
Tamarack/Carex (not described)
Treeless Bogs (not described)
Salix-Myrica (not described)
A
B
C
D
E
Oligotrophic (Poor)
Eutrophic
Nutrient Regime

Figure 8. Ecosystem associations of the Boreal Mixedwood Ecoregion.

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[1] Ecosystem associations that are not described for the Boreal Mixedwood Ecoregion but have similar counterparts described for other ecoregions.

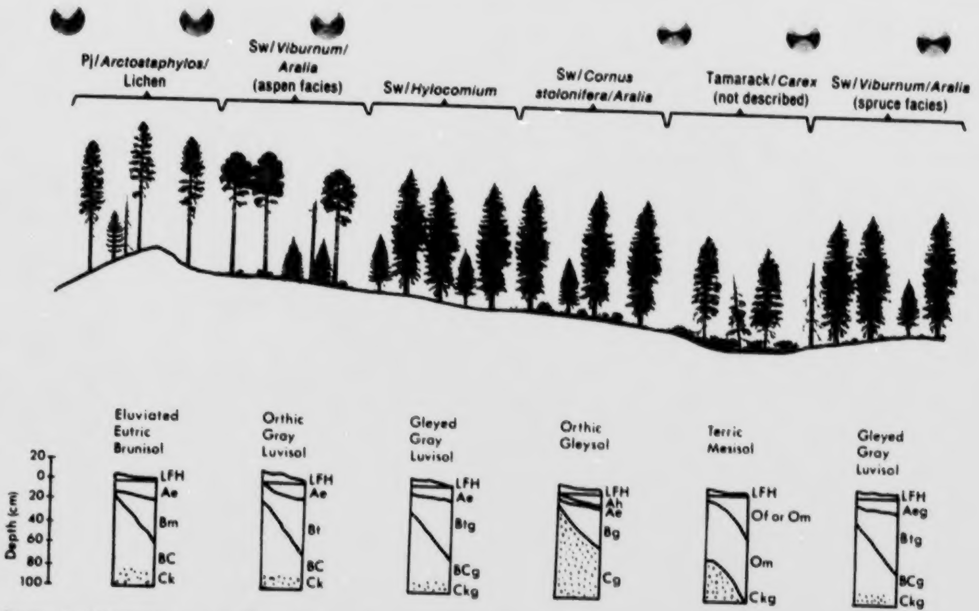
Pj/*Arctostaphylos*/ Lichen
Sw/*Viburnum*/ *Aralia* (aspen facies)
Sw/*Hylocomium*
Sw/*Cornus stolonifera*/*Aralia*
Tamarack/*Carex* (not described)
Sw/*Viburnum*/*Aralia* (spruce facies)
Depth (cm)
20
0
20
40
60
80
100
Eluviated Eutric Brunisol
LFH
Ae
Bm
BC
Ck
Orthic Gray Luvisol
LFH
Ae
Bt
BC
Ck
Gleyed Gray Luvisol
LFH
Ae
Btg
BCg
Ckg
Orthic Gleysol
LFH
Ah
Ae
Bg
Cg
Terric Mesisol
LFH
Of or Om
Om
Ckg
Gleyed Gray Luvisol
LFH
Aeg
Btg
BCg
Ckg

Figure 9. Schematic cross section of ecosystem associations of the Boreal Mixedwood Ecoregion.

ecoregion are not described in this guide. Nevertheless, management interpretations for the soils mapped in the area by Dumanski et al. (1972) are presented in Table 6, on pages 34-37.

Lower Boreal Cordilleran Ecoregion (LBC)

The Lower Boreal Cordilleran Ecoregion, which is similar to the Boreal Foothills Ecoregion of Strong and Leggat (1981), occurs at elevations of 800 to 1150 m, mainly on ground moraine of Continental (Keewatin) origin. The LBC/Upper Boreal Cordilleran (UBC) boundary is lower in the moister and/or cooler parts of the zone, occurring at 900 to 1050 m on the north slopes of the Kakwa-Berland and Little Smoky-Mayberne plateaus (Smoky River drainage basin). On the south slopes of these plateaus above the Athabasca and McLeod river valleys, the LBC/UBC boundary is much higher (up to 1150 m). The Lower Boreal Cordilleran Ecoregion is a transition zone between the primarily deciduous Boreal Mixedwood and the coniferous Upper Boreal Cordilleran ecoregions. Characteristic trees of upland sites are aspen, balsam poplar, white spruce, and lodgepole pine, and there are lesser amounts of black spruce (*Picea mariana*) and fir (*Abies* sp.[1]). The ecosystem associations of the Lower Boreal Cordilleran Ecoregion are shown in relation to moisture and nutrient regimes (Fig. 10) and in schematic cross section (Fig. 11).

The LBC Ecoregion, as outlined by Strong and Leggat (1981), is characterized by the codominant occurrence of aspen, balsam poplar, lodgepole pine, and white spruce. Mapping criteria used to separate the LBC from the BMW is the general absence of lodgepole pine on mesic sites in the BMW.

Upper Boreal Cordilleran Ecoregion (UBC)

The Upper Boreal Cordilleran Ecoregion, which is similar to the Boreal Uplands Ecoregion of Strong and Leggat (1981), occurs at elevations of 900 to 1500 m, commonly on till of both Continental and Cordilleran origin. The area is characterized by rolling topography and deep valleys.

Elevation ranges are from 900 to 1150 m for the lower boundary (LBC/UBC) and 1300 to 1500 m for the upper boundary (UBC/Subalpine [SA]). The UBC/SA boundary may drop to 1200 m in

---

[1] Attempts at separating *Abies balsamea* from *Abies lasiocarpa* in the field were unsuccessful. Treatment of the *Abies balsamea—lasiocarpa* complex in the taxonomic literature is confusing and often contradictory. For example, the complex is considered to be a single species (*A. balsamea*) by Boivin (1959), while Hunt and von Rudloff (1979) consider it to be three distinct species. Parker et al. (1981) conducted a detailed study on the morphological characteristics of cones and needles of *Abies* in western Canada and concluded that two distinct *Abies* taxa are not present. They did recognize two poorly differentiated taxa with a gradual break near the Rocky Mountain Crest and recommended that *Abies* east of the divide be considered *A. balsamea* and west of the divide *A. lasiocarpa*. Parker et al. (1981) also obtained similar results from analysis of needle flavinoid variation. In this guide the designation of *Abies* refers to either *Abies balsamea* or sp.

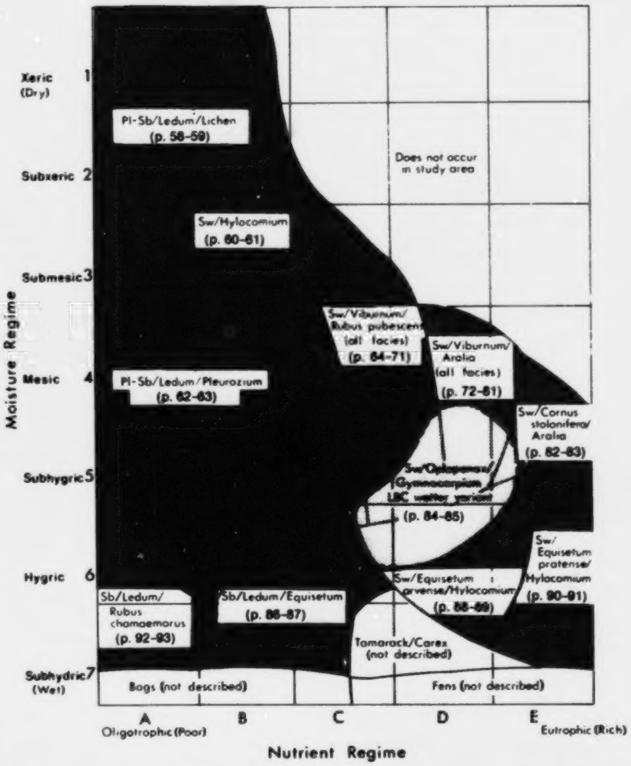

Figure 10. Ecosystem associations of the Lower Boreal Cordilleran Ecoregion.

moister parts of the study area, where topographic conditions may create cold air ponding such as found in the Sherman Meadows area. In apparently dryer parts of the study area, the UBC/SA boundary is much higher, as for example in the Obed Hills area.

The characteristic forest tree for the ecoregion is lodgepole pine, and there are varying intermixtures of white and black spruce and lesser amounts of aspen (especially at lower elevations, along river valleys, or on steep south aspects), balsam poplar,

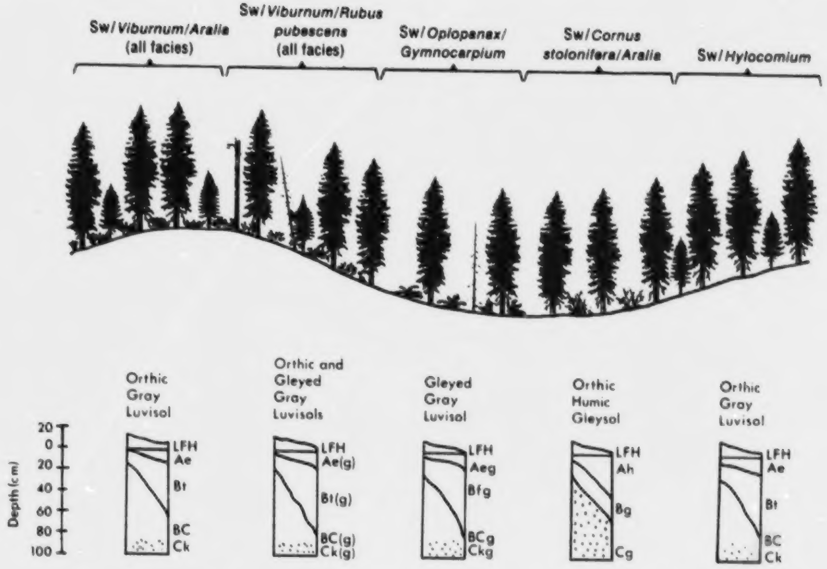
Sw/*Viburnum*/*Aralia* (all facies)
Sw/*Viburnum*/*Rubus pubescens* (all facies)
Sw/*Oplopanax*/*Gymnocarpium*
Sw/*Cornus stolonifera*/*Aralia*
Sw/*Hylocomium*
Orthic Gray Luvisol
Orthic and Gleyed Gray Luvisols
Gleyed Gray Luvisol
Orthic Humic Gleysol
Orthic Gray Luvisol
Depth (cm)
20
0
20
40
60
80
100
LFH
Ae
Bt
BC
Ck
Ae(g)
Bt(g)
BC(g)
Ck(g)
Aeg
Btg
BCg
Ckg
Ah
Bg
Cg

Figure 11. Schematic cross section of ecosystem associations of the Lower Boreal Cordilleran Ecoregion.

Continued on next page

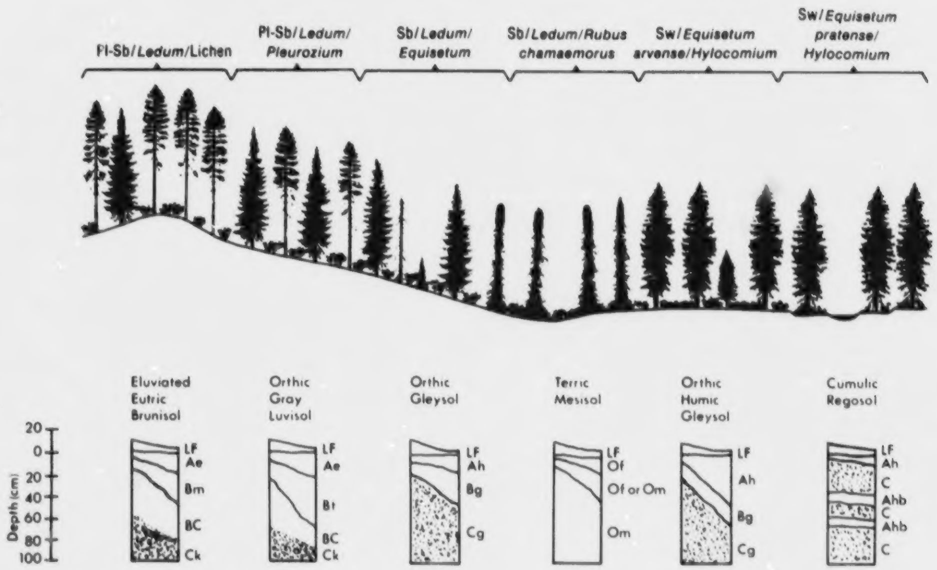
Pl-Sb/Ledum/Lichen
Pl-Sb/Ledum/Pleurozium
Sb/Ledum/Equisetum
Sb/Ledum/Rubus chamaemorus
Sw/Equisetum arvense/Hylocomium
Sw/Equisetum pratense/Hylocomium
Eluviated Eutric Brunisol
Orthic Gray Luvisol
Orthic Gleysol
Terric Mesisol
Orthic Humic Gleysol
Cumulic Regosol
Depth (cm)
20
0
20
40
60
80
100
LF
Ae
Bm
BC
Ck
LF
Ae
Bt
BC
Ck
LF
Ah
Bg
Cg
LF
Of
Of or Om
Om
LF
Ah
Bg
Cg
LF
Ah
C
Ahb
C
Ahb
C

Figure 11. continued

and fir. At higher elevations, hybridization of white and Engelmann spruce is observable in cone-scale morphology[2]. The ecosystem associations of the Upper Boreal Cordilleran Ecoregion are shown in relation to moisture and nutrient regimes (Fig. 12) and in schematic cross section (Fig. 13).

The mapping criterion used to separate the UBC from the LBC (Table 1) is the dominance of lodgepole pine on mesic sites in the UBC. Mesic sites in the LBC are usually dominated by aspen.

Subalpine Ecoregion (SA)

The Subalpine Ecoregion lies between elevations of 1300 (sometimes as low as 1200) and 2000 m and covers rolling topography and steep slopes of uplifted Mesozoic shales and sandstone. A thin veneer of Cordilleran till is often present. The closed-canopy ecosystem associations described in this report are representative of the lower Subalpine Eco-subregion.

Characteristic trees of the Subalpine Ecoregion are lodgepole pine, hybrid spruce (*Picea glauca* × *engelmannii*), fir, and black spruce. Aspen and balsam poplar may occur on exposed, warm, south-facing slopes. The major tree species coverage is controlled largely by fire-return intervals. Thus areas that are moister and cooler (higher elevations, north slopes, and frost pockets) have more hybrid spruce and fir in the canopies as they tend to burn less often and less severely. This increases the probability for viable spruce and fir seeds to be present after fires. Additionally, lodgepole pine cannot reproduce itself under its own canopy unless the stands are dry and open-canopied; therefore, the species is not favored by long fire-return intervals.

Map boundaries of the UBC/SA break were obtained by determining on the ground the elevations where subalpine species (i.e., hybrid spruce, *Rhododendron albiflorum*, *Menziesia glabella*, *Senecio triangularis*, and *Arnica latifolia*) become common. Extrapolations along topographic contours were then made to map the ecoregion. The ecosystem associations of the Subalpine Ecoregion are shown in relation to moisture and nutrient regimes (Fig. 14) and in schematic cross section (Fig. 15).

At the higher elevations of the SA Ecoregion, the forests become discontinuous and noncommercial and have stands of slow-growing trees interspersed with dwarf birch, willow, and heath communities. This upper Subalpine Eco-subregion is not discussed in this guide.

Alpine Tundra Ecoregion (AT)

The Alpine Tundra Ecoregion is an essentially treeless zone occurring at elevations above the

---

[2] Daubenmire (1974) studied taxonomic relationships between *Picea glauca* and *Picea engelmannii*, and from his conclusions it appears unlikely that pure *P. engelmannii* occurs in the study area, even at the highest elevations.

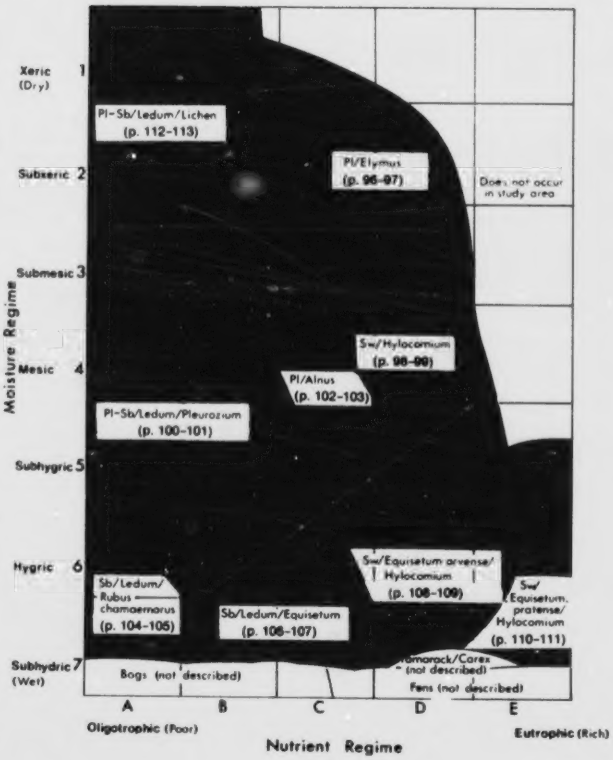
Xeric 1
(Dry)
Subxeric 2
Submesic 3
Mesic 4
Subhygric 5
Hygric 6
Subhydric 7
(Wet)
Moisture Regime
Pl-Sb/Ledum/Lichen
(p. 112-113)
Pl/Elymus
(p. 96-97)
Does not occur in study area
Sw/Hylocomium
(p. 98-99)
Pl/Alnus
(p. 102-103)
Pl-Sb/Ledum/Pleurozium
(p. 100-101)
Sb/Ledum/Rubus chamaemorus
(p. 104-105)
Sb/Ledum/Equisetum
(p. 106-107)
Sw/Equisetum arvense/Hylocomium
(p. 108-109)
Sw/Equisetum pratense/Hylocomium
(p. 110-111)
Tamarack/Carex (not described)
Bogs (not described)
Fens (not described)
A
B
C
D
E
Oligotrophic (Poor)
Eutrophic (Rich)
Nutrient Regime

Figure 12. Ecosystem associations of the Upper Boreal Cordilleran Ecoregion.

subalpine forests. This ecoregion is not discussed in this guide. The AT map boundaries utilized in this report were taken from preliminary biogeoclimatic zone maps produced by the Alberta Resource Evaluation and Planning Branch and from Strong and Leggat (1981).

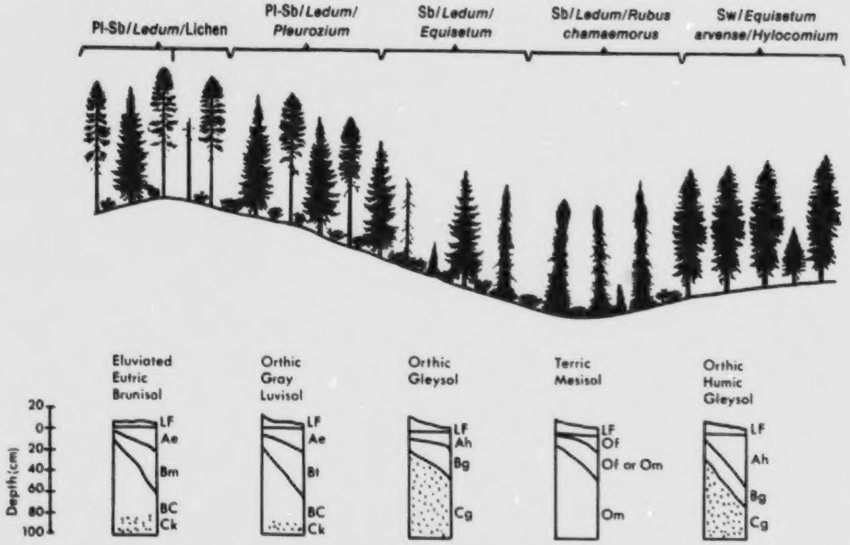
Pl-Sb/*Ledum*/Lichen
Pl-Sb/*Ledum*/*Pleurozium*
Sb/*Ledum*/*Equisetum*
Sb/*Ledum*/*Rubus chamaemorus*
Sw/*Equisetum arvense*/*Hylocomium*
Eluviated Eutric Brunisol
Orthic Gray Luvisol
Orthic Gleysol
Terric Mesisol
Orthic Humic Gleysol
Depth (cm)
20
0
20
40
60
80
100
LF
Ae
Bm
BC
Ck
LF
Ae
Bt
BC
Ck
LF
Ah
Bg
Cg
LF
Of
Of or Om
Om
LF
Ah
Bg
Cg

Figure 13. Schematic cross section of ecosystem associations of the Upper Boreal Cordilleran Ecoregion.

Continued on next page

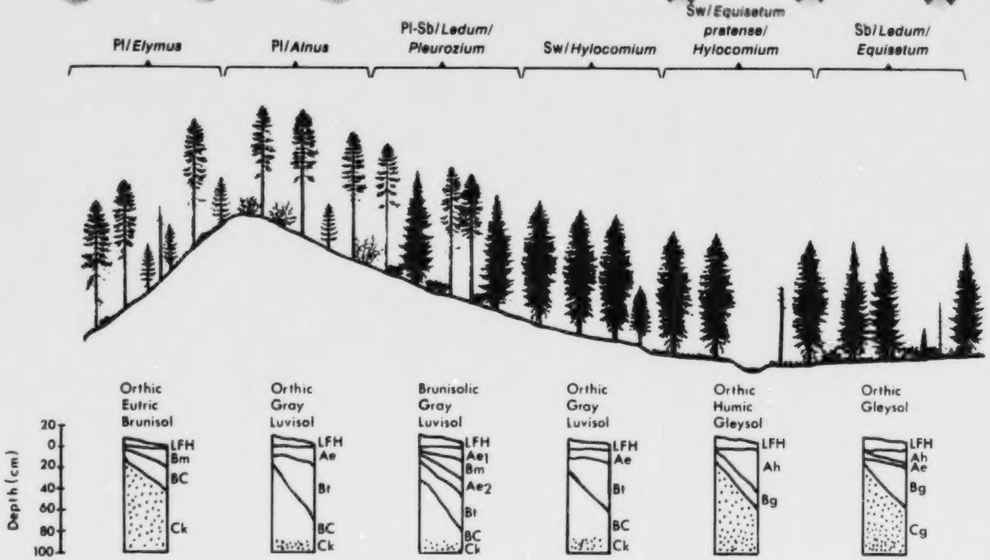
Pl/*Elymus*
Pl/*Alnus*
Pl-Sb/*Ledum*/*Pleurozium*
Sw/*Hylocomium*
Sw/*Equisetum pratense*/*Hylocomium*
Sb/*Ledum*/*Equisetum*
Orthic Eutric Brunisol
Orthic Gray Luvisol
Brunisolic Gray Luvisol
Orthic Gray Luvisol
Orthic Humic Gleysol
Orthic Gleysol
Depth (cm)
20
0
20
40
60
80
100
LFH
Bm
BC
Ck
LFH
Ae
Bt
BC
Ck
LFH
Ae1
Bm
Ae2
Bt
BC
Ck
LFH
Ae
Bt
BC
Ck
LFH
Ah
Bg
LFH
Ah
Ae
Bg
Cg

Figure 13. continued

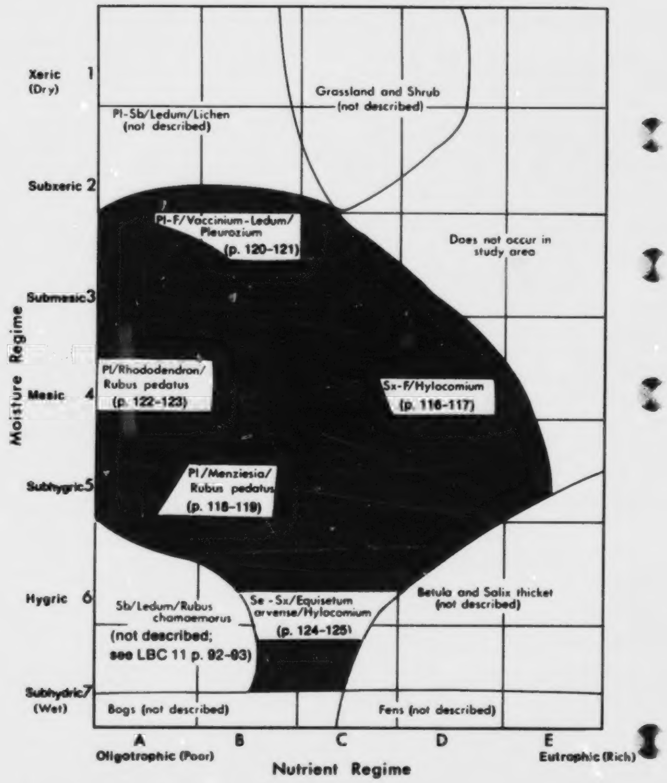

Figure 14. Ecosystem associations of the Subalpine Ecoregion.

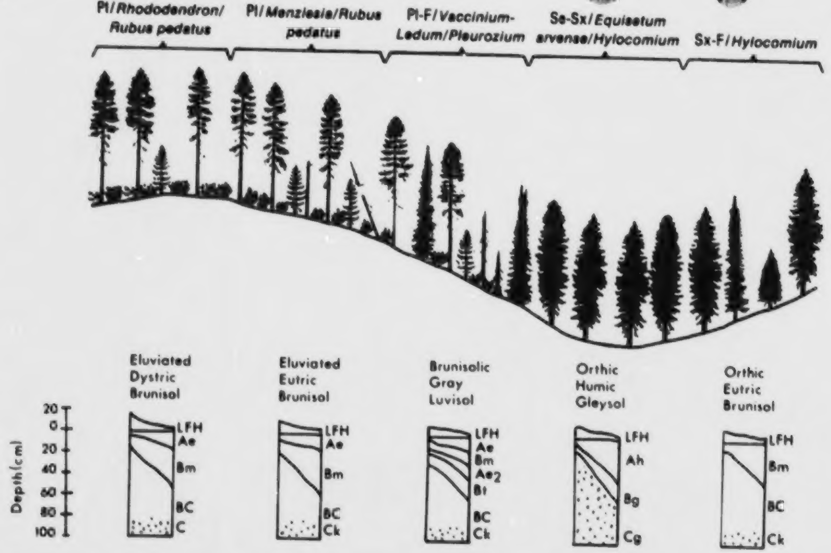
Pl/*Rhododendron/*
Rubus pedatus
Pl/*Menziesia/Rubus*
pedatus
Pl-F/*Vaccinium-*
Ledum/Pleurozium
Se-Sx/*Equisetum*
arvense/Hylocomium
Sx-F/*Hylocomium*
Eluviated
Dystric
Brunisol
Eluviated
Eutric
Brunisol
Brunisolic
Gray
Luvisol
Orthic
Humic
Gleysol
Orthic
Eutric
Brunisol
Depth (cm)
20
0
20
40
60
80
100
LFH
Ae
Bm
BC
C
LFH
Ae
Bm
BC
Ck
LFH
Ae
Bm
Ae2
Bt
BC
Ck
LFH
Ah
Bg
Cg
LFH
Bm
BC
Ck

Figure 15. Schematic cross section of ecosystem associations of the Subalpine Ecoregion.

ECOSYSTEM ASSOCIATIONS

The essence of this field guide is the section containing detailed ecosystem association descriptions. Each description has several components, which are explained in the following paragraphs.

The **title** contains, first, an abbreviation identifying the ecoregion and an association number (e.g., BMW 2 identifies the second association described for the Boreal Mixedwood Ecoregion). Secondly, the title lists in abbreviated form the dominant tree species plus the dominant genus of the understory vegetation layers. Slashes are used to separate layers, and dashes are used to separate species in the same layer. The full species name is used when the genus is not diagnostic. Most of the understory species are described later in the field guide in the section identifying common forest plants of west-central Alberta. Thirdly, common-name equivalents are given for the ecosystem association names.

A **moisture/nutrient grid** that is a miniature of the one in the ecoregion description is next. The ecosystem association being described is shaded on the miniature grid. The scales for the moisture/nutrient grid were explained in Figure 8 and, more completely, in Tables 2 and 3.

Below the moisture/nurtient grid is a **cross section** of a stand representative of the ecosystem association, shown as it relates topographically to another commonly occurring ecosystem association. The tree species and soil parent material symbols were described in Figure 5.

A small table of **forest management interpretations** is presented at the bottom of the first page of each association description. The interpretations are made within an ecosystem association framework and for the reconnaissance soil survey mapping units (Table 6) and are based upon a variety of sources, including reconnaissance soil survey data, available forest ecological information, and observations by operational foresters and the authors. Quantitative data were not available for many interpretations nor for some ecosystem associations and soil map units. In these instances data from similar environmental/ecological situations were extrapolated. Interpretations were made for a variety of attributes significant for forest management: potential productivity in site index (SI) and mean annual increment in total volume (MAI) for dominant species; season and method of harvest, site preparation intensity; soil compaction hazard; soil puddling hazard; soil water erosion hazard; reforestation species selection, method, and limitations; seedling frost heave hazard; type and severity of vegetational competition; windthrow hazard; and snowshoe hare damage hazard.

Summary tables used in making interpretive evaluations are included in the management interpretations section later in this field guide. Using these tables it is possible to determine management interpretations on a site-specific basis, in addition to on the basis of the more-generalized ecosystem associations or soil map units. Caution should be exercised in applying interpretations to situations where identification of the ecosystem association and/or soil properties/association is a problem. It is not intended that these interpretations should supercede any knowledge gained by the forest manager through systematic observation and experience. It is thus important to evaluate sites individually where site-specific information is desired and to revise management interpretations accordingly. The ratings should be regarded as provisional until more-detailed quantitative information is available.

The following abbreviations are used in the management interpretation table that accompanies each association description:

Season of harvest:
W = winter
A = all seasons

Logging method:
CC = clear-cutting
SC = selective cutting

Site preparation intensity, soil compaction hazard, soil puddling hazard, soil water erosion hazard, frost heave hazard, vegetational competition severity, windthrow hazard, snowshoe hare damage hazard:
L = low
M = moderate
H = high

Reforestation species:
Sw = white spruce
Sb = black spruce
Se = Engelmann spruce
Pl = lodgepole pine

Reforestation method:
DS = direct seeding
C = container
BR = bare root

On the second page, **characteristic species** (i.e., those with the highest percentage cover plus those occurring in 60% of more of the sample plots of an association) are listed with their average cover, which may vary considerably from location to location. The subheadings A, B, C, and D designate the tree, shrub (0.5 to 2.0 m), herb—dwarf shrub, and bryophyte layers, respectively. Many of these are illustrated in the plant identification section later in this guide.

A variety of **environmental information** is given next. The moisture regime is described as in Table 2 and is illustrated with the nutrient regime on the miniature moisture/nutrient grid on the first page. Soil pH is the degree of acidity or alkalinity of a soil. In naturally occurring forest soils, pH less than 5.5 is acid, pH 5.5 to 7.4 is neutral, and pH greater than 7.4 is alkaline (Canada Soil Survey Committee 1978). The various soil subgroups are described in the Canada Soil Survey Committee (1978) manual. Associated soil map units and associations have been described in several reconnaissance soil

Table 6. Forest management interpretations[1] for soil units/associations of the west-central Alberta study area
(Abbreviations used in this table are defined on page 33.)

Soil unit/ association[2]	Symbol	Optimum season of harvest	Logging method	Site preparation intensity	Soil compaction hazard	Soil puddling hazard	Soil water erosion hazard[3]
Alluvium	AV	W	CC	M	L	L	L
Blackmud	BKM	A	CC	L	M	L	H
Copton	COP	A	CC	L	M	M	H
Davis	DVS	W	CC	L	H	H	H
Deep Valley	DPV	A	CC	L	M-L	M	H
Donnelly	DON	W	CC	M	M	H	H
Edson	EDS	A	CC	M	M	H	M
Erith	ETH	W	CC	H	H	H	M-H
Errington	ERR	A	CC	L	M	L	L
Fickle	FKE	W	Leave	H	L	L	H
Goose	GOS	W	CC	H	M	M	H
Gunderson	GUN	W	CC	M	H	H	H
Heart	HRT	A	CC	L	L	L	M
Hinton	HTN	A	CC	M	L	L	L
Iosegun	IOS	W	CC	M	L	L	L
Jarvis	JRV	A	CC	L	L	L	L
Judy	JUY	A	CC	M	L	L	L
Kenzie	KNZ	W	Leave	H	L	L	H
Lendrum	LDM	W	CC	M	H	H	H
Lodge	LDG	W	CC	L	H	M	H
Maskuta	MSK	W	CC	L	H	M	H
Marlboro	MLB	W	CC	L-M	M-H	M	M
Mayberne	MBN	W	CC	L	H	M	M

Nampa	NMP	W	CC	M	M	H	H
Obed	OBD	A	CC	L	M	M	M
Putzy	PZY	A	CC	M	L	L	M
Robb	RBB	A	CC	M	M	M	L
Sheep	SHP	W	CC	M	H	M	H
Summit	SMT	A	CC	M	L	L	L
Smoky	SKY	W	CC	H	H	M	M
Snipe	SIP	W	CC	M	M	H	H
Toad	TOD	W	CC	L	H	H	M
Torrens	TOR	W	CC	M	H	M	H
Tri Creek	TRC	W	CC	M	H	H	H
Wanham	WHM	W	CC	M	H	H	H

Table 6 continues on the next two pages

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[1] Interpretations for each map unit are in most cases based upon the predominant soil represented by the map unit symbol. Map units with significant (15-40%) inclusions of wet soils will have interpretations that reflect the wet condition. (Maps at 1:250 000 or 1:500 000 for any of the above interpretations can be produced at the user's expense.)

[2] Soil units/associations are described in reconnaissance soil survey reports by Dumanski et al. (1972), Knapik and Lindsay (1983), and Twardy and Corns (1980).

[3] Soil erosion hazard is based upon the predominant slopes occurring on the soil unit. Significantly steeper or more gradual slopes may alter the hazard rating.

Table 6. continued

Soil unit/ association	Symbol	Reforestation species	Reforestation method[4]	Frost heave hazard[5]	Vegetational competition severity	Windthrow hazard[6]	Snowshoe hare damage hazard
Alluvium	AV	Sw	BR, C	M	M	M	M
Blackmud	BKM	Pl, Sw	C, DS	L	L	L	L
Copton	COP	Pl, Sw,	C, DS	M	M	L	M
Davis	DVS	Pl, Sw	C, BR	M-H	H	L	H
Deep Valley	DPV	Pl	C, DS	L	M	M	M
Donnelly	DON	Sw, Pl	BR, C	H	H	M	H
Edson	EDS	Sw, Pl	C, BR	M	M-H	L	H
Erith	ETH	Sb	BR, C	H	H	H	M
Errington	ERR	Sw, Pl	C, DS	L-M	L	L	L
Fickle	FKE	Sb	BR	H	M	H	L
Goose	GOS	Sw, Sb	BR, C	H	H	H	M
Gunderson	GUN	Sb, Sw	BR, C	H	H	H	M
Heart	HRT	Pl	C	L	L	L	L
Hinton	HTN	Sw	C	L	M	L	M
Iosegun	IOS	Sw	BR, C	M	M	M	M
Jarvis	JRV	Pl	C	L	L	L	L
Judy	JUY	Pl, Sw	C, BR	L	M	L	L
Kenzie	KNZ	Sb	BR	H	M	H	L
Lendrum	LDM	Pl, Sw	C, BR	H	M	M	H
Lodge	LDG	Sw, Pl	C, DS	L-M	L	M	H
Maskuta	MSK	Pl	C, DS	L	M	L	M
Marlboro	MLB	Pl, Sw	C, DS	M	M	L	M
Mayberne	MBN	Pl, Sw	C, DS	M	M	L	M

Nampa	NMP	Sw, Pl	BR, C	H	H	M	H
Obed	OBD	Pl, Sw	C, DS	M	M	L	L
Putzy	PZY	Pl, Se	C, DS	M	M	L	M
Robb	RBB	Pl, Se	C, DS	M	M	L	M
Sheep	SHP	Pl, Se	C, DS	M	M	L	M
Summit	SMT	Pl, Sw	C, BR	L	M	L	L
Smoky	SKY	Sb, Sw	BR, C	H	H	H	M
Snipe	SIP	Sw, Sb	BR, C	H	H	M-H	H
Toad	TOD	Pl	C, DS	M	M	L	M
Torrens	TOR	Pl, Sw	C, DS	H	M	L	M
Tri Creek	TRC	Sw, Pl	BR, C	H	M-H	L	M
Wanham	WHM	Sb, Sw	BR, C	H	H	M-H	M

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[4] The authors recognize the limited successes of direct seeding of conifers in Alberta. Direct seeding is indicated as an alternative for sites that should be most receptive, i.e., those that are neither too wet nor too dry and do not have high vegetation competition or rodent damage hazards. Direct seeding should be done on snow in spring. Additional research is required on the operational suitability of direct seeding.

[5] Frost heave hazard ratings for soil units with complex slopes represent the mid- to upper-slope positions. Lower- to toe-slope positions where cold air may accumulate may be expected to have a rating at least one class more severe.

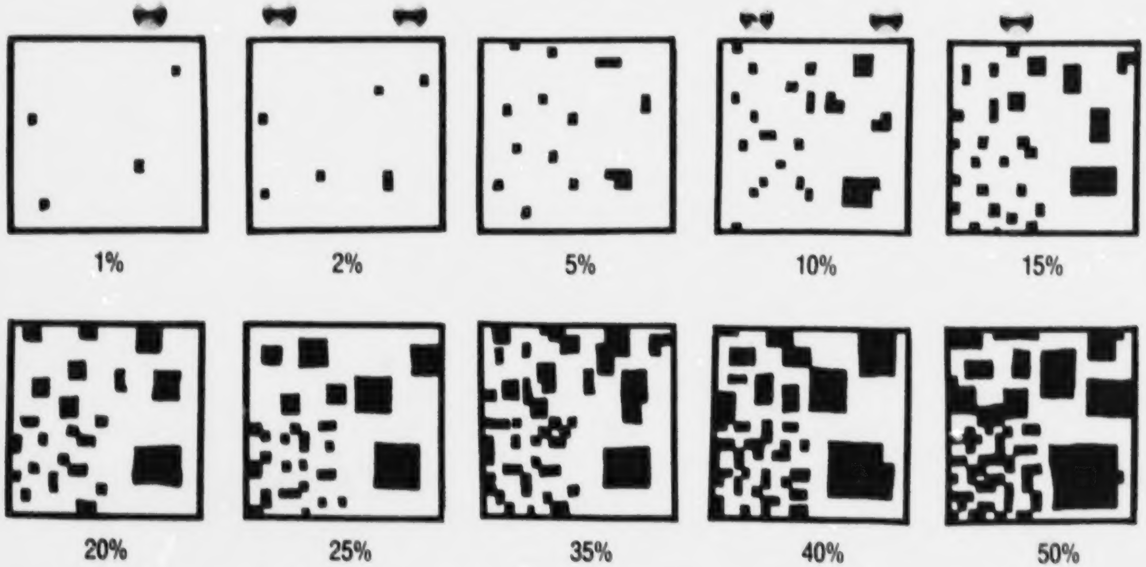
[6] Windthrow hazard is rated assuming there is an average slope and exposure to strong winds. Local topography and exposure are not taken into account and will alter the ratings where these are extreme.

survey reports: Dumanski et al. (1972) for the Hinton-Edson map area; Twardy and Corns (1980) for the Wapiti map area; and Knapik and Lindsay (1983) for the Iosegun Lake map area. The symbols used in this field guide are defined in Table 6. Aids to soil property descriptions were given in Table 2 for ecological moisture regime, Table 4 for mineral horizon descriptions, Table 5 for forest humus horizons and humus types, Figures 4 and 5 for texture, and Figure 6 for drainage. Landforms are defined in the glossary.

Average **productivity** is expressed as mean annual increment in total volume (MAI) and as site index (SI) in height at age 70 of the dominant tree species occurring in sample plots in natural, unmanaged stands. The **number of sample plots** for each association is also given. **Successional relationships, similar associations**, and brief miscellaneous **comments** (relating mainly to forest management) conclude each ecosystem association description.

KEY TO THE MAJOR ECOSYSTEM ASSOCIATIONS

The following key to the major ecosystem associations enables the user to quickly locate in the guide a particular ecosystem association description. Phases of associations (e.g., those distinguished on the basis of soil texture) are not separate in the key, unlike in the individual ecosystem association descriptions where the separation criteria are important factors affecting forest management interpretations. Species indicated in the key as dominant (highest percentage cover) may sometimes have their cover exceeded by other species, so the key leads should not be too rigidly interpreted. An aid to estimating percentage cover is presented in Figure 16. Polychotomous leads have been used to save space and simplify the key. Not all forest stands can be located in the key, as only the most common associations have been included (i.e., those with the largest areal extent and amount of quantitative data). The detailed association descriptions should be consulted to verify the determination.



1%
2%
5%
10%
15%
20%
25%
35%
40%
50%

Figure 16. Guide for estimating proportions of mottles and coarse fragments and percentage vegetation cover. Each quarter of any one square has the same amount of black.

KEY TO THE MAJOR ECOSYSTEM ASSOCIATIONS

1a. Broad-leaved tree dominant .... key lead 2

1b. Needle-leaved tree dominant .... key lead 3

2a. Dominant tree *Populus tremuloides* or *Betula papyrifera: Cornus stolonifera* and *Equisetum* spp. in small amounts or absent

  2a1. *Aralia nudicaulis* a dominant herb, parent materials mainly till and lacustrine, slopes 0-35% .... Sw/*Viburnum/Aralia*

    c1. Elevations below 800 m; BMW Ecoregion .... p. 50

    c2. Elevations above 800 m; LBC Ecoregion .... p. 72

      d1. *Populus tremuloides* dominant tree—aspen facies .... p. 78

      d2. *Betula papyrifera* dominant tree—birch facies .... p. 80

  2a2. *Aralia nudicaulis* absent or of minor occurrence, parent materials mainly till and lacustrine, slopes 0-15%; LBC Ecoregion .... Sw/*Viburnum/Rubus pubescens* .... p. 64

    2e1. *Populus tremuloides* dominant tree—aspen facies .... p. 70

2b. Dominant tree *Populus balsamifera* or a mixture with *Populus tremuloides; Cornus stolonifera* a dominant shrub; *Equisetum arvense* a dominant herb; BMW and LBC ecoregions.

  2b1. *Equisetum pratense* uncommon, fluvial, lacustrine and till parent materials; BMW and LBC ecoregions—Sw/*Cornus stolonifera/Aralia* .... p. 52, 82

  2b2. *Equisetum pratense* a dominant herb, fluvial parent materials on recent floodplains; BMW and LBC ecoregions—Sw/*Equisetum pratense/Hylocomium* .. p. 90

  (Balsam poplar facies not described)

3. Dominant tree: *Pinus contorta; Picea* spp. may be codominant .... key lead 4

   Dominant tree: *Picea glauca* .... key lead 5

   Dominant tree: *Picea* hybrid (*P. glauca* × *engelmannii)* or *P. engelmannii* .... key lead 6

   Dominant tree: *Picea mariana* .... key lead 7

4. Dominant tree: *Pinus contorta; Picea* spp. may be codominant.

  4a. Dry sites; rapidly drained sands and gravels; dominant shrubs *Vaccinium myrtilloides* with *Ledum groenlandicum.* Lichens *(Cladina, Cladonia* and/or

Stereocaulon) dominate the moss layer. Parent materials coarse sandy or gravelly fluvial deposits or eolian sands .... Pl-Sb/*Ledum*/Lichen

4a1. Elevations less than 800 m; BMW Ecoregion; *Pinus banksiana* may occur—Pl-Pj/*Arctostaphylos*/lichen .... p. 46

4a2. Elevations greater than 800 m; LBC and UBC ecoregions—Pl-Sb/*Ledum*/lichen............. p. 58, 112

4b. Dry sites; rapidly drained tills and colluvium; south exposures in foothills; grassy understory dominated by *Elymus innovatus,* shrub cover sparce—Pl/*Elymus*.... p. 96

4c. *Alnus crispa* clearly dominates the shrub layer (cover generally greater than 25%); parent materials, till and residual; UBC Ecoregion—Pl/*Alnus*.................. p. 102

4d. *Picea mariana* common. *Ledum groenlandicum* and *Vaccinium* spp. dominate the shrub layers. The herb layer poorly developed (<20% with relatively few species). The moss layer well developed (>60%). Mostly tills and residual, also with lacustrine material at lower elevations—Pl-Sb/*Ledum*/*Pleurozium*

4d1. *Vaccinium myrtilloides* dominant, *V. membranaceum* rare or absent, parent materials mainly till and lacustrine; LBC and BMW ecoregions—Pl-Sb/*Ledum*/ *Pleurozium* .... p. 62, 54

4d2. Both *V. membranaceum* and *V. myrtilloides* common.

2(a) *Abies* uncommon, parent materials till and residual, UBC Ecoregion—Pl-Sb/*Ledum*/*Pleurozium*........................ p. 100

2(b) *Abies* frequent in community, *Picea mariana* becoming less frequent with elevation. Subalpine species such as *Rhododendron albiflorum* or *Menziesia glabella* in general area, parent materials till and residual; SA Ecoregion—Pl-F/*Vaccinium-Ledum*/*Pleurozium*......... p. 120

4e. *Rhododendron albiflorum* dominant shrub. Parent materials mainly tills; SA Ecoregion—Pl/*Rhododendron*/*Rubus pedatus* .... p. 122

4f. *Menziesia glabella* dominant shrub. Parent materials mainly tills; SA Ecoregion—Pl/*Menziesia*/*Rubus pedatus* .... p. 118

4g. *Viburnum edule* a dominant shrub, wide variety of herbs present, parent materials mainly till; LBC Ecoregion.

4g1. *Aralia* common—Sw/*Viburnum*/*Aralia* (pine facies)................................... p. 76

4g2. *Aralia* absent or rare—Sw/*Viburnum*/*Rubus pubescens* (pine facies)......................... p. 68

Continued on next page

5. Dominant tree: *Picea glauca*

5a. Shrub understory prominant; till or lacustrine parent materials, mesic to subhygric sites.

5a1. *Viburnum edule* a dominant shrub; *Cornus stolonifera* and *Oplopanax* lacking, parent materials predominantly till and lacustrine; BMW and LBC ecoregions.

i. *Aralia nudicaulis* a dominant herb—Sw/ *Viburnum/Aralia* (spruce facies) .... p. 74

ii. *Aralia nudicaulis* rare or absent—Sw/ *Viburnum/Rubus pubescens* (spruce facies) .. p. 66

5a2. *Cornus stolonifera* a dominant shrub, *Equisetum arvense* common, parent materials predominantly fluvial and lacustrine; BMW and LBC ecoregions—Sw/*Cornus stolonifera/Aralia* .... p. 52, 82

5a3. *Oplopanax horridus* a dominant shrub, *Equisetum arvense* common, parent materials predominantly till; LBC Ecoregion—Sw/*Oplopanax/ Gymnocarpium* .... p. 84

5b. Shrub understory sparce or absent.

5b1. Herbs sparse (<15%) understory dominated by feather moss (>50%)—Sw/*Hylocomium*

i. Elevations below 800 m, parent materials lacustrine and fine textured till, slopes 0-2%; BMW Ecoregion .... p. 48

ii. Elevations 800-1150 m, till and lacustrine parent materials, slopes 0-20%; LBC Ecoregion .... p. 60

iii. Elevations 1150-1500 m, till and residual parent materials, slopes 0-35%; UBC Ecoregion .... p. 98

5b2. Abundant *Equisetum* spp. (>12%) and other herbs (>15%), feather moss abundant (>50%), soils usually poorly drained.

i. *Equisetum arvense* a dominant herb. Seepage sites in tills, lacustrine or fluvial parent materials—Sw/*Equisetum arvense/Hylocomium*

ia. Elevations below 1150 m; LBC Ecoregion ... p. 88

ib. Elevation 1150-1500 m; UBC Ecoregion.... p. 108

ii. *Equisetum pratense* a dominant herb, *Circaea alpina* usually present in small amounts. Recent or active floodplains—Sw*Equisetum pratense/ Hylocomium*

iia. Elevations below 1150 m; LBC Ecoregion ... p. 90

iib. Elevations above 1150 m; UBC Ecoregion .. p. 110

6. Dominant tree *Picea* hybrid (*P. glauca* × *engelmannii*) or *P. engelmannii*. Shrub understory sparse. Parent materials mainly tills and colluvium; SA Ecoregion.

    6a. Understory dominated by *Hylocomium splendens*; soils well drained—Sx-F/*Hylocomium* .... p. 116

    6b. Understory dominated by *Equisetum* spp. and *Hylocomium splendens*; soils poorly drained—Se-Sx/*Equisetum*/*Hylocomium* .... p. 124

7. Dominant tree *Picea mariana*

    7a. *Ledum groenlandicum* and feather moss dominate the understory. Parent materials mostly tills or lacustrine. Soils often gleyed, poorly drained or on north aspects—Pl-Sb/*Ledum*/*Pleurozium*

        i. Elevations below 1150 m; LBC and BMW ecoregions .... p. 62, 54

        ii. Elevations above 1150 m; UBC Ecoregion .... p. 100

    7b. *Equisetum (scirpoides, sylvaticum, arvense)* are dominant herbs. Bog species uncommon. Soils poorly drained Gleysols, Mesisols and Fibric Humisols on various parent materials—Sb/*Ledum*/*Equisetum*

        i. Elevations below 1150 m; LBC and BMW ecoregions .... p. 86

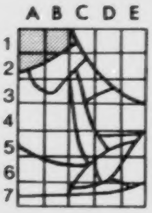
        ii. Elevations above 1150 m; UBC Ecoregion .... p. 106

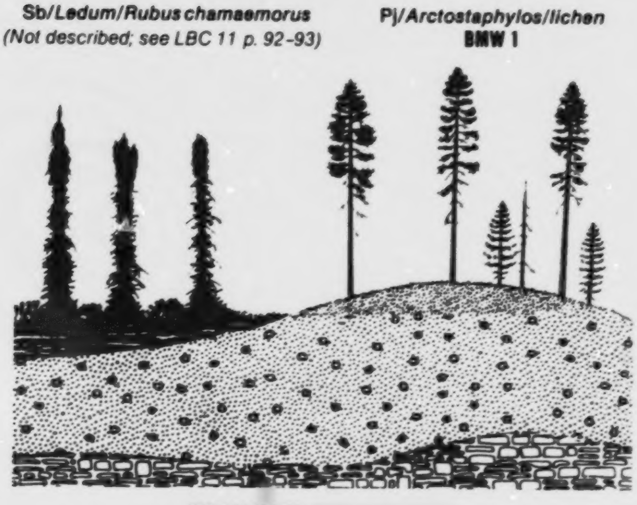
    7c. Bog species (*Rubus chamaemorus, Oxycoccus microcarpus, Sphagnum* spp.) common. Soils poorly drained Mesisols and Fibrisols on organic parent materials; LBC and UBC ecoregions—Sb/*Ledum*/*Rubus chamaemorus* .... p. 92, 104

BOREAL MIXEDWOOD (BMW) ECOREGION

BMW 1

Pj/*Arctostaphylos*/lichen
(jack pine/bearberry/lichen)


A B C D E
1
2
3
4
5
6
7


Sb/Ledum/Rubus chamaemorus
(Not described; see LBC 11 p. 92-93)
Pj/Arctostaphylos/lichen
BMW 1

MANAGEMENT INTERPRETATIONS

						REFORESTATION				VEGETATIONAL COMPETITION			
SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY	WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
A	CC	L	L	L	L	Pl	C, DS	↑ drought	L	↑ *Elymus*	L	M	L

Pj/*Arctostaphylos*/lichen

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* or
P. banksiana (44)

B. *Vaccinium myrtilloides* (22)
Ledum groenlandicum (12)
Rosa acicularis (1)

C. *Vaccinium vitis-idaea* (13)
Arctostaphylos uva-ursi (3)
Cornus canadensis (1)
Linnaea borealis (1)

D. *Pleurozium schreberi* (60)
Cladina mitis (22)
Cladina rangiferina (16)
Ptilium crista-castrensis (4)
Dicranum polysetum (1)
Cladina alpestris (1)
Peltigera aphthosa (1)
Hylocomium splendens (1)
Cladonia gracilis (+)[1]
Cetraria ericetorum (+)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Subxeric to submesic (2–3)

pH REGIME (MEAN):
Humus: — (3.6)
Mineral: 4.4–4.7 (4.6)

ELEVATION RANGE (MEAN):
670–880 (750) m

PERCENT SLOPE GRADIENT (MEAN): 0–4 (2)

ASPECT: Variable

SOIL SUBGROUPS: Eluviated Dystric Brunisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: BKM, HRT, JRV

SOIL DRAINAGE: Rapidly to well

LANDFORM: Eolian

PRODUCTIVITY:

MAI (MEAN):
1.1-2.6 (2.1) m^3/ha/yr

SI at 70 (MEAN): Pj — (15) m
Pl — (15) m

NUMBER OF PLOTS: 5

SUCCESSIONAL RELATIONSHIPS:

This association tends to be successionally stable, with pine cover tending to be maintained and reproduced for long periods of time due to the dry site conditions, which make spruce establishment very difficult. Succession to spruces is either very slow or absent.

SIMILAR ASSOCIATIONS:

This association is similar to the Pl-Sb/*Ledum*/lichen association that occurs at higher elevations in the Lower and Upper Boreal Cordilleran ecoregions (LBC 1, UBC 9), where precipitation is greater. It corresponds to the *Pinus contorta/Vaccinium myrtilloides /Cladonia* association of Archibald et al. (1984).

COMMENTS:

These sites tend to be droughty, require minimal site preparation, and have minimal plant competition with tree seedlings.

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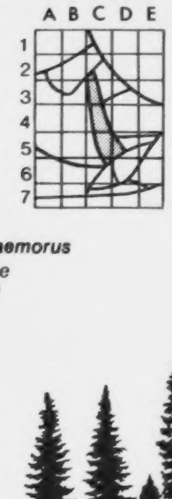
[1] + indicates less than 0.5% cover.

BMW 2

Sw/Hylocomium
(white spruce/feather moss)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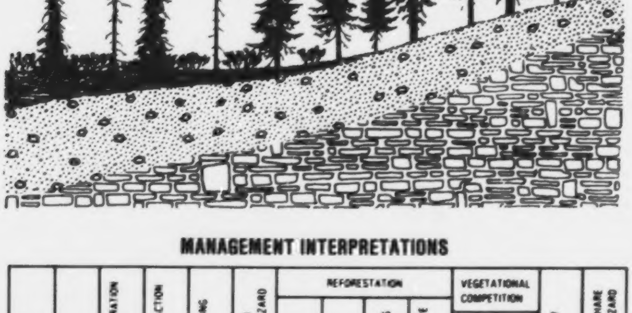
Sb/Ledum/Rubus chamaemorus
(Not described; see LBC 11 p. 92-93)
Sw/Hylocomium
BMW 2

MANAGEMENT INTERPRETATIONS

						REFORESTATION				VEGETATIONAL COMPETITION			
SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY	WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
W	CC	M	M-H	M-H	M-H	Sw	BR, C	excess moisture on some sites	M-H	*Calamagrostis*, forbs	M	M	M

Sw/Hylocomium

CHARACTERISTIC SPECIES:
[with % cover]

A. *Picea glauca* (35)
   Populus tremuloides (16)
   Abies balsamea (10)

B. *Rosa acicularis* (1)

C. *Cornus canadensis* (15)
   Linnaea borealis (7)
   Petasites palmatus (2)
   Maianthemum canadense (1)
   Mertensia paniculata (1)
   Mitella nuda (1)
   Calamagrostis canadensis (+)[1]
   Pyrola asarifolia (+)
   Orthilia secunda (+)
   Rubus pubescens (+)
   Epilobium angustifolium (+)
   Goodyera repens (+)

D. *Hylocomium splendens* (33)
   Pleurozium schreberi (25)
   Ptilium crista-castrensis (22)
   Cladonia chlorophaea (2)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Subhygric to mesic (5–4)

pH REGIME (MEAN):
Humus: 4.4–5.1 (4.7)
Mineral: 4.1–4.2 (4.2)

ELEVATION RANGE (MEAN): 680–890 (800) m

PERCENT SLOPE GRADIENT (MEAN): 0–2 (1)

ASPECT: Mostly level

SOIL SUBGROUPS: Orthic Gray Luvisols and Orthic Luvic Gleysols

ASSOCIATED SOIL UNIT/ ASSOCIATION: DON, SIP, TRC

SOIL DRAINAGE: Moderately well to poorly

LANDFORM: Lacustrine, morainal

PRODUCTIVITY:

MAI (MEAN):
3.1–4.6 (3.6) m^3/ha/yr

SI at 70 (MEAN): Sw 11–21 (15) m
At 17–18 (18) m

NUMBER OF PLOTS: 4

SUCCESSIONAL RELATIONSHIPS:

This association is successionally mature. *Abies* sp. may form a significant component of stands over 100 years. Stands of this association may once have been dominated by aspen (e.g., Sw/*Viburnum/Aralia*, aspen facies).

SIMILAR ASSOCIATIONS:

Stands with plentiful shrub and herb cover may be transitional to Sw/*Viburnum/Aralia* or Sw/*Viburnum/Rubus pubescens*. This association has affinities with the *Picea glauca/Lonicera involucrata/Rubus pubescens association* of Archibald et al. (1984).

COMMENTS:

When the forest cover is removed, vegetation cover may be expected to increase greatly, to the point where competition problems may occur, especially on moist, fine-textured soils.

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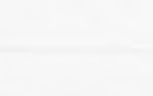
[1] + indicates less than 0.5% cover.

BMW 3

***Sw/Viburnum/Aralia*, aspen facies**
(white spruce/mooseberry/wild sarsaparilla)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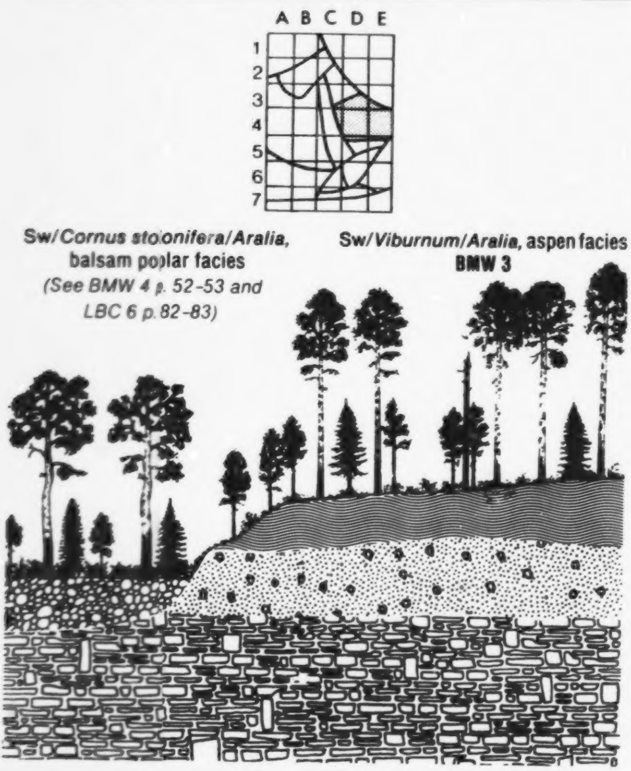

Sw/*Cornus stolonifera*/*Aralia*, balsam poplar facies
(See BMW 4 p. 52-53 and LBC 6 p. 82-83)
Sw/*Viburnum*/*Aralia*, aspen facies
BMW 3

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	M-H	M-H	M-H	Sw	BR, C	↑	M-H	↑	H	M	H

aspen, *Calamagrostis*, forbs, shrubs

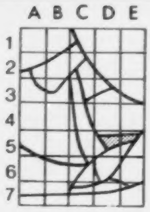
excess moisture on some sites

Sw/*Viburnum*/*Aralia*, aspen facies

Data for this association are few within the study area and are included in the corresponding ecosystem association described for the Lower Boreal Cordilleran Ecoregion (LBC 5c), on pages 78-79. Aspen and spruce facies are recognized.

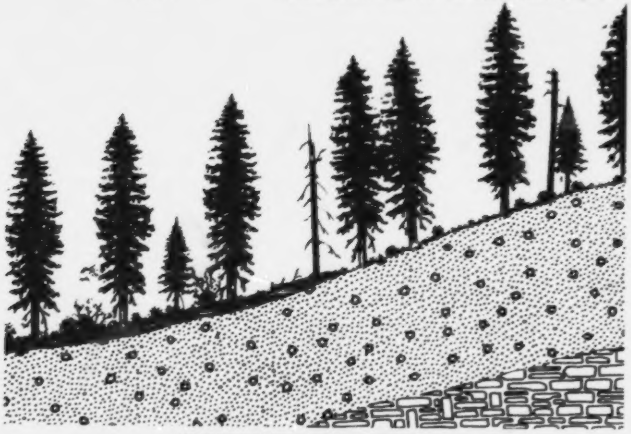
BMW 4

Sw/Cornus stolonifera/Aralia
(white spruce/red osier dogwood/wild sarsaparilla)



Sw/Cornus stolonifera/Aralia
BMW 4

Sw/Viburnum/Aralia
(See BMW 3 p. 50-51 and LBC 5a p. 74-75)



MANAGEMENT INTERPRETATIONS

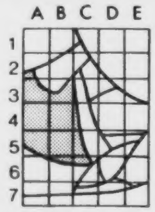
	SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
							SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
FLUVIAL SITES	A	CC	L	L	L	H	Sw	BR	↑ excess moisture	M-H	↑ forbs, shrubs	H	M-H	H
LACUSTRINE AND MORAINAL SITES	W	CC	M	M-H	M-H	M-H	Sw	BR	↑ excess moisture	M-H	↑ forbs, shrubs	H	M-H	H

Sw/*Cornus stolonifera*/*Aralia*

Data for this association are few within the study area and are included in the corresponding ecosystem association described for the Lower Boreal Cordilleran Ecoregion (LBC 6), on pages 82-83.

BMW 5

Pl-Sb/*Ledum/Pleurozium*
(lodgepole pine—black spruce/Labrador tea/ feather moss)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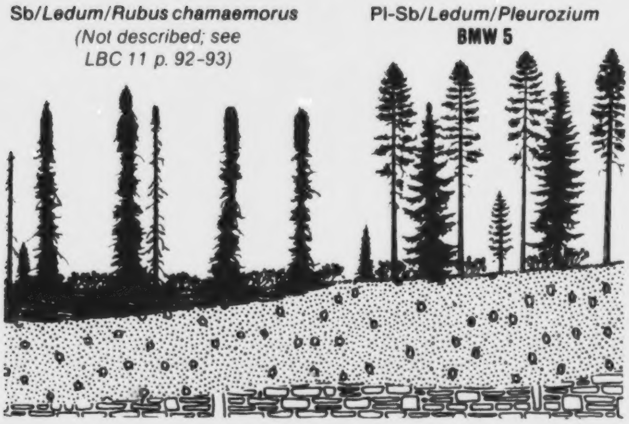

Sb/*Ledum/Rubus chamaemorus*
(Not described; see LBC 11 p. 92-93)
Pl-Sb/*Ledum/Pleurozium*
BMW 5

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY[1]		
A	CC	L	M-H	L	M-H	Pl, Sw	C, DS	↑ drought some sites	L	↑ *Elymus, Calamagrostis*	L-M	L-M	L-M
MEDIUM TO COARSE TEXTURED, MODERATELY WELL TO RAPIDLY DRAINED, L-H GENERALLY <10 cm													
A	CC	M	M-H	M-H	M-H	Pl, Sw	C, DS	↑ excess moisture on some sites	M	↑ *Calamagrostis*	M	M	M
MODERATELY FINE TO FINE TEXTURED, IMPERFECTLY TO MODERATELY WELL DRAINED, L-H GENERALLY >10 cm													

Pl-Sb/*Ledum*/*Pleurozium*

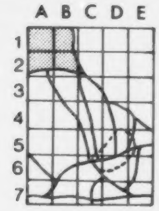
Data for this association are few within the study area and are included in the corresponding ecosystem association described for the Lower Boreal Cordilleran Ecoregion (LBC 3). on pages 62-63.

LOWER BOREAL CORDILLERAN (LBC) ECOREGION

LBC 1

Pl-Sb/*Ledum*/lichen

(lodgepole pine—black spruce/Labrador tea/ lichen)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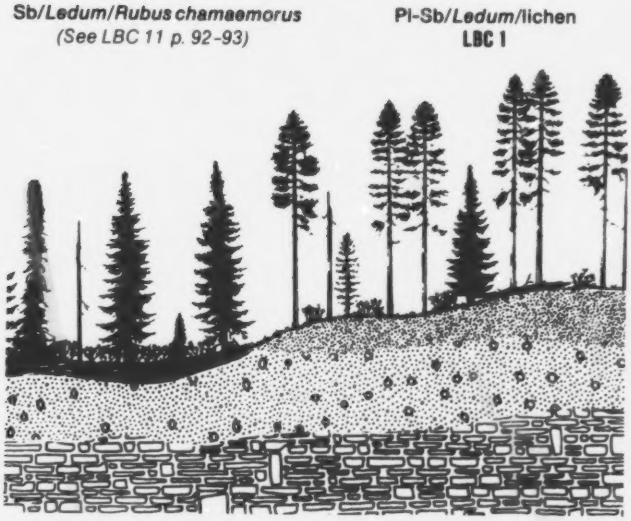
Sb/*Ledum*/*Rubus chamaemorus*
(*See LBC 11 p. 92-93*)
Pl-Sb/*Ledum*/lichen
LBC 1

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
A	CC	L	L	L	M	Pl	C, DS	↑ drought	L	↑ *Elymus*	L	L	L-M

Pl-Sb/*Ledum*/lichen

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (18)
   Picea mariana (7)
   Picea glauca (2)

B. *Ledum groenlandicum* (23)
   Vaccinium myrtilloides (6)
   Rosa acicularis (2)
   Spiraea betulifolia (1)

C. *Vaccinium vitis-idaea* (15)
   Linnaea borealis (3)
   Epilobium angustifolium (3)
   Cornus canadensis (2)
   Arctostaphylos uva-ursi (2)
   Vaccinium caespitosum (1)

D. *Pleurozium schreberi* (39)
   Hylocomium splendens (17)
   Cladina rangiferiana (8)
   Cladina mitis (6)
   Ptilium crista-castrensis (5)
   Peltigera aphthosa (3)
   Dicranum polysetum (2)
   Cladonia gracilis (1)
   Cladina stellaris[1] (1)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Submesic to xeric (subxeric) (3–1(2))

pH REGIME (MEAN):
Humus: 2.8–3.8 (3.3)
Mineral: 4.0–4.5 (4.3)

ELEVATION RANGE (MEAN): 850–1300 (1126) m

PERCENT SLOPE GRADIENT (MEAN): 0–20 (4)

ASPECT: Variable

SOIL SUBGROUPS: Brunisolic Gray Luvisols, Eluviated Dystric Brunisols

ASSOCIATED SOIL UNIT/ASSOCIATION: BKM, HRT, JRV, LDG

SOIL DRAINAGE: Well to rapidly

LANDFORM: Fluvial, eolian

PRODUCTIVITY:

MAI (MEAN): 1.3–6.4 (3.5) m³/ha/yr

SI at 70 (MEAN): Pl 11–19 (14) m

NUMBER OF PLOTS: 16

SUCCESSIONAL RELATIONSHIPS:

This association is successionally mature. Lodgepole pine is likely to maintain dominance over the black spruce throughout the life of the stand.

SIMILAR ASSOCIATIONS:

This association corresponds to the *Pinus contorta/Ledum groenlandicum/Cladonia* spp. association of Archibald et al. (1984) and is similar to the Pl/bearberry/lichen association of Robertson et al. (1984).

COMMENTS:

Stands of this association tend to be droughty, and difficulty in establishing tree seedlings during dry conditions is expected. The often gravelly soils result in good trafficability and low site impact from heavy machinery.

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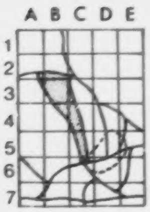
[1] Species characteristic of the association but occurring in less than 80% of the sample plots.

LBC 2

Sw/Hylocomium
(white spruce/feather moss)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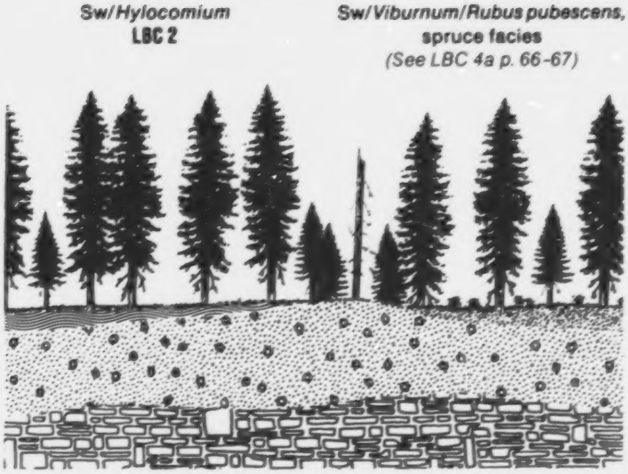

Sw/Hylocomium
LBC 2
Sw/Viburnum/Rubus pubescens,
spruce facies
(See LBC 4a p. 66-67)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	M-H	M-H	M-H	Sw	BR, C	↑	M-H	↑	M	M	M

Calamagrostis, forbs

excess moisture on some sites

Sw/*Hylocomium*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea glauca* (51)
Populus tremuloides (13)

B. *Rosa acicularis* (3)
Viburnum edule (1)
Lonicera involucrata (1)

C. *Cornus canadensis* (8)
Linnaea borealis (3)
Rubus pubescens (3)
Petasites palmatus (1)
Mertensia paniculata (1)
Mitella nuda (1)
Epilobium angustifolium (1)
Maianthemum canadense (1)
Fragaria virginiana (1)

D *Hylocomium splendens* (52)
Pleurozium schreberi (9)
Ptilium crista-castrensis (2)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Mesic, occasionally up to hygric (4)

pH REGIME (MEAN):
Humus: 4.2–7.0 (5.6)
Mineral: 4.1–6.0 (5.1)

ELEVATION RANGE (MEAN): 650–910 (800) m

PERCENT SLOPE GRADIENT (MEAN): 0–22 (8)

ASPECT: Level to northerly

SOIL SUBGROUPS: Orthic and Gleyed Gray Luvisols, Orthic Gleysols

ASSOCIATED SOIL UNIT/ ASSOCIATION: DON, IOS (AV), LDG, LDM, NMP, SIP

SOIL DRAINAGE: Moderately well (well to poorly)

LANDFORM: Lacustrine, morainal, fluvial

PRODUCTIVITY:

MAI (MEAN):
4.0–7.5 (4.4) m³/ha/yr

SI at 70 (MEAN): Sw 15–23 (17) m

NUMBER OF PLOTS: 15

SUCCESSIONAL RELATIONSHIPS:

This association is successionally mature. *Abies* sp. may form a significant component of stands over 150 years. Stands of this association may once have been dominated by aspen (e.g., Sw/*Viburnum*/*Aralia*, aspen facies).

SIMILAR ASSOCIATIONS:

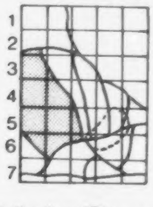
Stands with plentiful shrub and herb cover may be transitional to Sw/*Viburnum*/*Aralia* or Sw/*Viburnum*/*Rubus pubescens*. This association corresponds to the *Picea glauca*/feather moss association of Archibald et al. (1984).

COMMENTS:

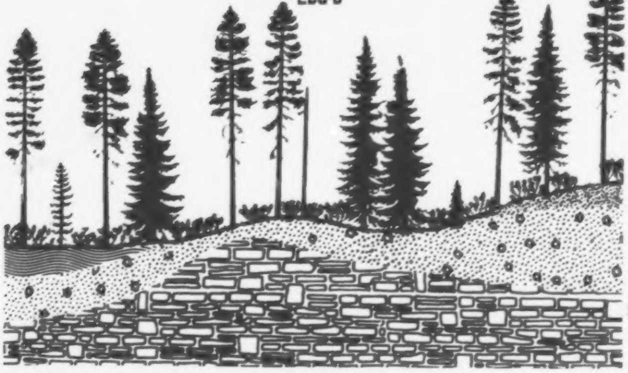
When the forest cover is removed, vegetation cover may be expected to increase greatly, to the point where competition problems may occur, especially on moist, fine-textured soils.

LBC 3

Pl-Sb/*Ledum*/*Pleurozium*
(lodgepole pine—black spruce/Labrador tea/ feather moss)



Pl-Sb/*Ledum*/*Pleurozium*
LBC 3



MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION: SPECIES SELECTION	REFORESTATION: METHOD	REFORESTATION: LIMITATIONS	REFORESTATION: FROST HEAVE HAZARD	VEGETATIONAL COMPETITION: TYPE	VEGETATIONAL COMPETITION: SEVERITY	WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
A	CC	L	M-H	L	M-H	Pl, Sw	C, DS	↑ drought some sites	L	↑ *Elymus, Calamagrostis*	L-M	L-M	L-M
A	CC	M	M-H	M-H	M-H	Pl, Sw	C, DS	↑ excess moisture on some sites	M	↑ *Calamagrostis*	M	M	M

First row: MEDIUM TO COARSE TEXTURED, MODERATELY WELL TO RAPIDLY DRAINED, L-H GENERALLY <10 cm

Second row: MODERATELY FINE TO FINE TEXTURED, IMPERFECTLY TO MODERATELY WELL DRAINED, L-H GENERALLY >10 cm

Pl-Sb/*Ledum*/*Pleurozium*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (35)
   Picea mariana (16)

B. *Ledum groenlandicum* (25)
   Vaccinium myrtilloides[1] (4)
   Rosa acicularis (1)

C. *Vaccinium vitis-idaea* (11)
   Cornus canadensis (10)
   Linnaea borealis (5)
   Petasites palmatus (1)
   Epilobium angustifolium (1)

D. *Pleurozium schreberi* (46)
   Ptilium crista-castrensis (18)
   Hylocomium splendens (16)
   Dicranum polysetum[1] (2)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic to subhygric (4–5)

pH REGIME (MEAN):
Humus: 3.0–5.2 (4.0)
Mineral: 3.9–6.2 (4.8)

ELEVATION RANGE (MEAN):
740–1200 (940) m

PERCENT SLOPE GRADIENT (MEAN): 0–12 (5)

ASPECT: Variable

SOIL SUBGROUPS: Orthic, Brunisolic and Gleyed Gray Luvisols, Eluviated Dystric Brunisols

ASSOCIATED SOIL UNIT/ASSOCIATION: BKM, DON, EDS, HRT, JRV, LDG, LDM, MBN, MLB, SIP, TOD

SOIL DRAINAGE: Moderately well to imperfectly

LANDFORM: Morainal, lacustrine

PRODUCTIVITY:

MAI (MEAN):
2.1–5.7 (3.8) m³/ha/yr

SI at 70 (MEAN): Sb 10–18 (13) m
Pl 14–22 (18) m
Sw 10–20 (15) m

NUMBER OF PLOTS: 35

SUCCESSIONAL RELATIONSHIPS:

These forests have a fire origin and can persist for over 150 years. Successionally mature stands (greater than 150 years) tend to be dominated by *Picea mariana* and *Abies* sp. and have occasional residual pine.

SIMILAR ASSOCIATIONS:

Dry sites may be transitional to the Pl-Sb/*Ledum*/lichen association, while wet sites may be dominated by black spruce and have a thick organic layer. There is a Pl-Sb/*Ledum*/*Pleurozium* association counterpart in the Upper Boreal Cordilleran Ecoregion (UBC 3). This association corresponds to the *Pinus contorta*/ *Picea mariana*/*Ledum groenlandicum*/*Pleurozium schreberi* association of Archibald et al. (1984) and the Pl-Sb/Labrador tea/bog cranberry/feather moss association of Robertson et al. (1984).

COMMENTS:

This association is the most extensive in the LBC ecoregion and occurs on a wide range of soils. Soil type will influence the management of these sites; two phases are recognized.

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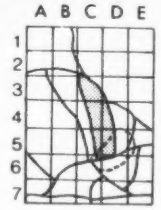
[1] Species characteristic of the association but occurring in less than 60% of the sample plots.

LBC 4

Sw/Viburnum/Rubus pubescens, all facies
(white spruce/mooseberry/dewberry)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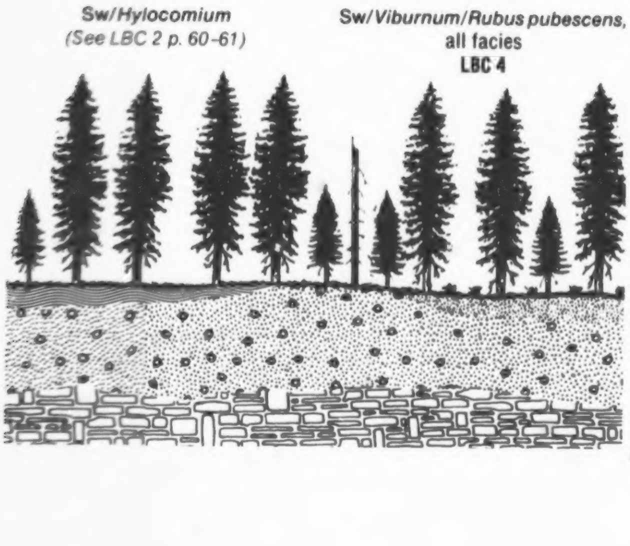
Sw/Hylocomium
(See LBC 2 p. 60-61)
Sw/Viburnum/Rubus pubescens,
all facies
LBC 4

Sw/*Viburnum*/*Rubus pubescens*, all facies

CHARACTERISTIC SPECIES:
(with % cover)

A. *Populus tremuloides* (26)
   Picea glauca (21)

B. *Viburnum edule* (5)
   Lonicera involucrata (2)
   Rosa acicularis (1)

C. *Cornus canadensis* (10)
   Calamagrostis canadensis (5)
   Linnaea borealis (4)
   Rubus pubescens (3)
   Epilobium angustifolium (3)
   Petasites palmatus (2)
   Mertensia paniculata (2)
   Lathyrus ochroleucus (2)
   Pyrola asarifolia (1)
   Mitella nuda (1)
   Maianthemum canadense (1)
   Fragaria virginiana (1)
   Equisetum arvense (1)
   Galium boreale (+)[1]

D. *Hylocomium splendens* (19)
   Pleurozium schreberi (11)
   Ptilium crista-castrensis (5)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Mesic to subhygric (4–5)

pH REGIME (MEAN):
Humus: 3.9–6.5 (5.3)
Mineral: 3.9–6.2 (5.2)

ELEVATION RANGE (MEAN): 655–1070 (858) m

PERCENT SLOPE GRADIENT (MEAN): 0–15 (4)

ASPECT: Variable

SOIL SUBGROUPS: Orthic and Gleyed Gray Luvisols, Orthic Luvic Gleysols

ASSOCIATED SOIL UNIT/ ASSOCIATION: BKM, DON, DVS, EDS, HRT, LDG, LDM, NMP, SIP, TRC

SOIL DRAINAGE: Moderately well to poorly

LANDFORM: Morainal, lacustrine

PRODUCTIVITY:

MAI (MEAN):
2.6–6.5 (4.4) m³/ha/yr

SI at 70 (MEAN): Sw 14–22 (18) m
At 15–24 (21) m
Pl 14–21 (19) m

NUMBER OF PLOTS: 39

SUCCESSIONAL RELATIONSHIPS:

This association has several facies that differ by the dominant tree species present, namely, white spruce, lodgepole pine, and aspen. The white spruce facies is the most stable, and stands dominated by pine or aspen will gradually succeed to white spruce.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sw/*Viburnum*/*Aralia* association of the LBC Ecoregion (LBC 5) but differs by having less *Aralia* and more *Rubus pubescens* and by occurring on slightly drier sites.

COMMENTS:

This association is very common in the LBC Ecoregion of Alberta. Management interpretations are to some extent dependent on the present dominant tree species and are given separately for each facies of the association.

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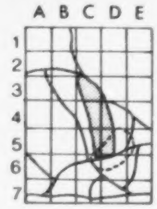
[1] + indicates less than 0.5% cover.

Sw/*Viburnum/Rubus pubescens*, spruce facies
(white spruce/mooseberry/dewberry)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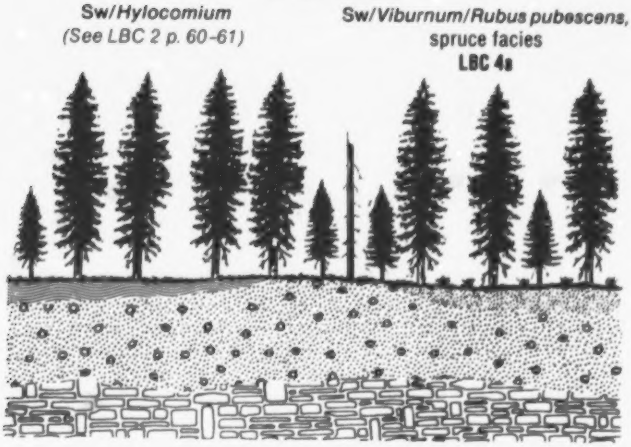
Sw/*Hylocomium*
(See LBC 2 p. 60-61)
Sw/*Viburnum/Rubus pubescens*, spruce facies
LBC 4a

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	M-H	M-H	M-H	Sw, Pl	BR, C	excess moisture on some sites	M-H	*Calamagrostis*, forbs, shrubs	H	M	H

***Sw/Viburnum/Rubus pubescens*, spruce facies**

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea glauca* (45)
   Populus tremuloides (8)

B. *Viburnum edule* (6)
   Lonicera involucrata (3)
   Rosa acicularis (2)

C. *Cornus canadensis* (9)
   Linnaea borealis (5)
   Calamagrostis canadensis[1] (5)
   Rubus pubescens (4)
   Mertensia paniculata (3)
   Mitella nuda (2)
   Petasites palmatus (2)
   Epilobium angustifolium (2)
   Pyrola asarifolia (+)[2]

D. *Hylocomium splendens* (34)
   Pleurozium schreberi (13)
   Ptilium crista-castrensis (10)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic to hygric (4–6)

pH REGIME (MEAN):
Humus: 4.2–6.5 (5.2)
Mineral: 3.9–6.6 (5.4)

ELEVATION RANGE (MEAN):
670–1070 (870) m

PERCENT SLOPE GRADIENT (MEAN): 0–10 (4)

ASPECT: Variable

SOIL SUBGROUPS: Orthic Luvic Gleysols, Orthic and Gleyed Gray Luvisols, Gleyed Eutric Brunisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: BKM, DON, DVS, EDS, LDG, LDM, NMP, SIP, TRC

SOIL DRAINAGE: Moderately well to poorly

LANDFORM: Morainal, lacustrine

PRODUCTIVITY:

MAI (MEAN):
2.6–5.8 (4.7) m^3/ha/yr

SI at 70 (MEAN): Sw 15–21 (18) m
Pl 19–21 (20) m

NUMBER OF PLOTS: 14

SUCCESSIONAL RELATIONSHIPS:

These forests are successionally mature. *Abies* sp. may form a significant component of stands over 100 years. Some of the forests may have succeeded from moist aspen forests (e.g., Sw/*Viburnum/Rubus pubescens*, aspen facies) over a period of 50 to 100 years.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sw/*Viburnum/Aralia* association, which is somewhat moister. Stands with sparse shrub and herb cover may be transitional to the Sw/*Hylocomium* association. It corresponds to the *Picea glauca/Viburnum edule/Rubus pubescens* association of Archibald et al. (1984).

COMMENTS:

When the forest cover is removed, vegetation cover (especially *Calamagrostis canadensis*) may be expected to increase greatly, competing with tree seedlings. Suckering may be stimulated in aspen, which may increase significantly in number after logging.

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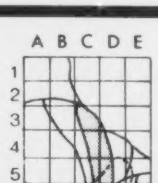
[1] Species characteristic of this association but occurring in less than 60% of the sample plots.

[2] + indicates less than 0.5% cover.

LBC 4b

Sw/*Viburnum/Rubus pubescens*, pine facies

(white spruce/mooseberry/dewberry)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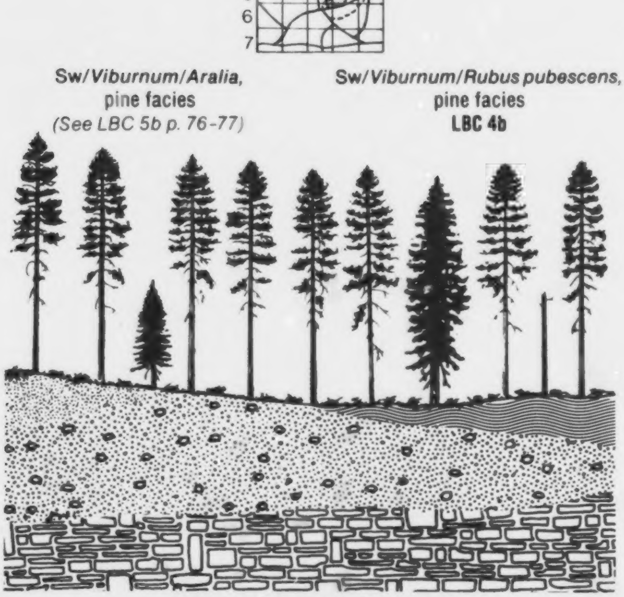

Sw/*Viburnum/Aralia*, pine facies
(See LBC 5b p. 76-77)
Sw/*Viburnum/Rubus pubescens*, pine facies
LBC 4b

MANAGEMENT INTERPRETATIONS

						REFORESTATION				VEGETATIONAL COMPETITION			
SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY	WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
W	CC	M	M-H	M-H	M-H	Sw, Pl	BR, C	↑	M-H	↑	H	M	H

Calamagrostis, forbs, shrubs

excess moisture on some sites

Sw/Viburnum/Rubus pubescens, pine facies

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (42)
   Picea glauca (8)

B. *Viburnum edule* (5)
   Ledum groenlandicum (2)
   Rosa acicularis (1)
   Lonicera involucrata (1)

C. *Cornus canadensis* (14)
   Linnaea borealis (3)

D. *Rubus pubescens* (3)
   Petasites palmatus (2)
   Epilobium angustifolium (2)
   Mitella nuda (1)
   Viola renifolia (+)[1]

E. *Pleurozium schreberi* (23)
   Hylocomium splendens (13)
   Ptilium crista-castrensis (8)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Mesic to subhygric (4-5)

pH REGIME (MEAN):
Humus: 3.9-5.0 (4.4)
Mineral: 3.6-5.6 (4.6)

ELEVATION RANGE (MEAN): 880-1140 (960) m

PERCENT SLOPE GRADIENT (MEAN): 0-15 (6)

ASPECT: Variable

SOIL SUBGROUPS: Eluviated and Orthic Eutric Brunisols, Gleyed Gray Luvisols, Dystric Brunisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: BKM, DON, DVS, EDS, HRT, LDG, LDM, NMP, SIP, TRC

SOIL DRAINAGE: Well to imperfectly

LANDFORM: Morainal, lacustrine

PRODUCTIVITY:

MAI (MEAN):
2.4-6.5 (4.1) m^3/ha/yr

SI at 70 (MEAN): Pl 14-21 (19) m
Sw 16-20 (18) m

NUMBER OF PLOTS: 7

SUCCESSIONAL RELATIONSHIPS:

These forests are successionally quite stable, but gradual replacement of pine by spruce may occur over long time periods. These pine forests have a fire origin.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sw/*Viburnum/Aralia* association, pine facies, which is somewhat moister and has more *Aralia* cover and less *Rubus pubescens*. Stands with sparse shrub and herb cover and a significant spruce component may be transitional to the Sw/*Hylocomium* association. It is included in the *Pinus contorta/Viburnum edule/Aralia nudicaulis* association of Archibald et al. (1984).

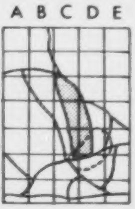
COMMENTS:

When the trees are removed, competing vegetation (especially *Calamagrostis canadensis*) may be expected to increase greatly, smothering new tree seedlings.

+ indicates less than 0.5% cover.

***Sw/Viburnum/Rubus pubescens,* aspen facies**

(white spruce/mooseberry/dewberry)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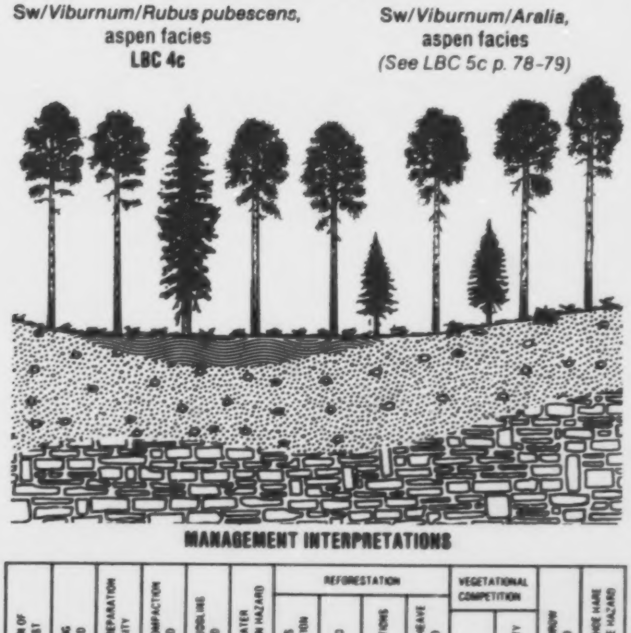

Sw/Viburnum/Rubus pubescens,
aspen facies
LBC 4c
Sw/Viburnum/Aralia,
aspen facies
(See LBC 5c p. 78-79)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	M-H	M-H	M-H	Sw, Pl	BR, C	↑	M-H	↑	H	M	H

aspen, *Calamagrostis*, forbs, shrubs

excess moisture on some sites

LBC 4c

Sw/*Viburnum/Rubus pubescens*, aspen facies

CHARACTERISTIC SPECIES:
(with % cover)

A. *Populus tremuloides* (42)
Picea glauca (14)

B. *Viburnum edule* (6)
Shepherdia canadensis (4)
Rosa acicularis (3)
Lonicera involucrata (2)

C. *Cornus canadensis* (9)
Calamagrostis canadensis (6)
Epilobium angustifolium (3)
Linnaea borealis (3)
Lathyrus ochroleucus (3)
Rubus pubescens (2)
Petasites palmatus (2)
Mertensia paniculata (2)
Elymus innovatus (2)
Pyrola asarifolia (1)
Maianthemum canadense (1)
Fragaria virginiana (1)
Galium boreale (1)
Equisetum arvense (1)

D. *Hylocomium splendens* (11)
Pleurozium schreberi (6)
Ptilium crista-castrensis (1)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic to subhygric (4–5)

pH REGIME (MEAN):
Humus: 4.9–6.4 (5.6)
Mineral: 4.4–6.6 (5.1)

ELEVATION RANGE (MEAN):
710–1010 (820) m

PERCENT SLOPE GRADIENT (MEAN): 0–15 (4)

ASPECT: Variable

SOIL SUBGROUPS: Orthic and Gleyed Gray Luvisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: BKM, DON, DVS, EDS, LDG, LDM, NMP, SIP, TRC

SOIL DRAINAGE: Moderately well to imperfectly

LANDFORM: Morainal, lacustrine

PRODUCTIVITY:

MAI (MEAN):
3.0–6.2 (4.3) m^3/ha/yr

SI at 70 (MEAN): At 15–24 (21) m
Sw 14–25 (18) m

NUMBER OF PLOTS: 19

SUCCESSIONAL RELATIONSHIPS:

These forests generally have a fire origin and should eventually succeed to white spruce (Sw/*Viburnum/Rubus pubescens*) in 100 to 150 years.

SIMILAR ASSOCIATIONS:

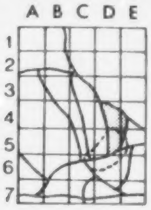
This association is most similar to the Sw/*Viburnum/Aralia* association, aspen facies, which is somewhat drier and has more *Aralia* cover and less *Rubus pubescens*. It is included in the *Populus tremuloides/Viburnum edule/Aralia nudicaulis* association of Archibald et al. (1984) and in the A-Sw/low-bush cranberry/sarsaparilla association of Robertson et al. (1984).

COMMENTS:

When the trees are cut, aspen suckers and *Calamagrostis canadensis* cover can be expected to increase dramatically, competing with planted conifer seedlings. Such sites are good candidates for vegetation control.

LBC 5

Sw/*Viburnum/Aralia*, all facies
(white spruce/mooseberry/wild sarsaparilla)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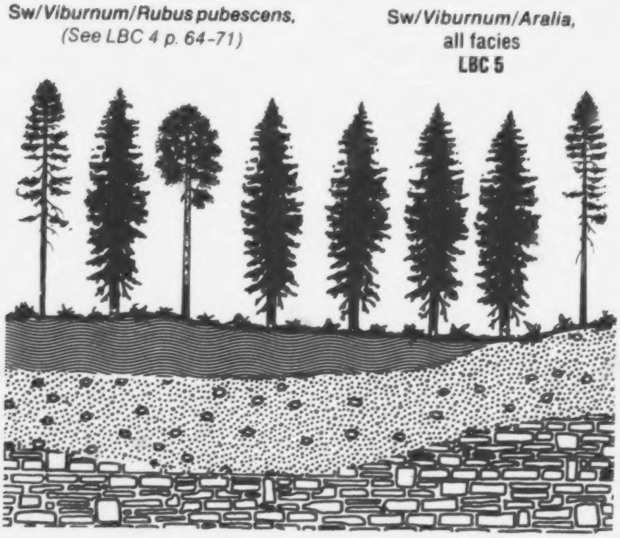

Sw/Viburnum/Rubus pubescens,
(See LBC 4 p. 64-71)
Sw/Viburnum/Aralia,
all facies
LBC 5

Sw/*Viburnum*/*Aralia*, all facies

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea glauca* (15)

B. *Viburnum edule* (12)
Rosa acicularis (5)
Lonicera involucrata (4)
Ribes lacustre (1)
Amelanchier alnifolia (1)

C. *Aralia nudicaulis* (19)
Cornus canadensis (9)
Linnaea borealis (7)
Rubus pubescens (6)
Calamagrostis canadensis (5)
Mitella nuda (3)
Mertensia paniculata (3)
Lathyrus ochroleucus (2)
Maianthemum canadense (1)
Petasites palmatus (1)
Epilobium angustifolium (1)
Pyrola asarifolia (1)

D. *Pleurozium schreberi* (13)
Hylocomium splendens (13)
Ptilium crista-castrensis (7)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic to subhygric (4–5)

pH REGIME (MEAN):
Humus: 4.1–6.5 (5.0)
Mineral: 3.9–7.7 (5.1)

ELEVATION RANGE (MEAN):
575–1060 (864) m

PERCENT SLOPE GRADIENT (MEAN): 0–37 (6)

ASPECT: Variable

SOIL SUBGROUPS: Orthic, Gleyed, and Brunisolic Gray Luvisols, Eluviated Eutric Brunisols

ASSOCIATED SOIL UNIT/ASSOCIATION: BKM, COP (MSK), DVS, DON, EDS, ESH, HRT, LDG, LDM, NMP, SIP, TOR, TRC

SOIL DRAINAGE: Moderately well to imperfectly

LANDFORM: Morainal, lacustrine, residual

PRODUCTIVITY:

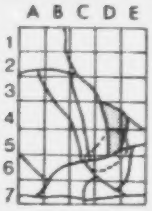
MAI (MEAN):
2.1–6.7 (5.2) m^3/ha/yr

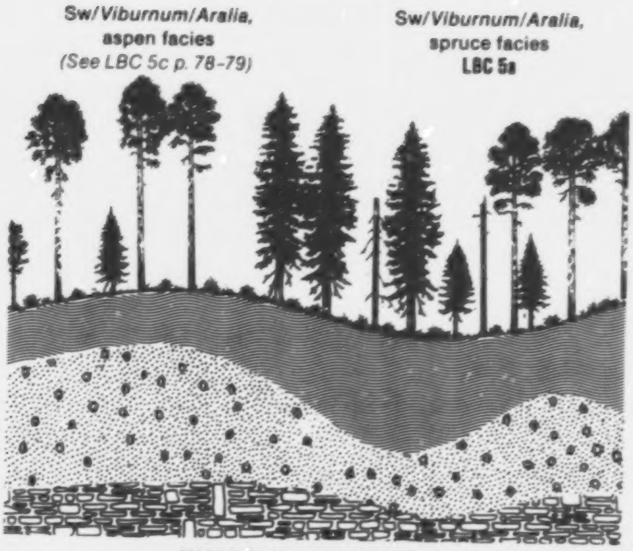
SI at 70 (MEAN): Sw 12–31 (21) m
Pl 16–31 (22) m
At 21–29 (23) m
Pb 19–31 (23) m

NUMBER OF PLOTS: 48

LBC 5a

Sw/*Viburnum*/*Aralia*, spruce facies
(white spruce/mooseberry/wild sarsaparilla)




Sw/*Viburnum*/*Aralia*,
aspen facies
(See LBC 5c p. 78–79)
Sw/*Viburnum*/*Aralia*,
spruce facies
LBC 5a

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	M-H	M-H	M-H	Sw, Pl	BR, C	↑ excess moisture on some sites	M-H	↑ *Calamagrostis*, forbs, shrubs	H	M	H

Sw/*Viburnum*/*Aralia*, spruce facies

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea glauca* (51)
   Populus tremuloides (7)

B. *Viburnum edule* (13)
   Rosa acicularis (5)
   Ribes lacustre (1)
   Amelanchier alnifolia (+)[1]

C. *Aralia nudicaulis* (14)
   Cornus canadensis (10)
   Linnaea borealis (9)
   Rubus pubescens (7)
   Mitella nuda (7)
   Mertensia paniculata (4)
   Calamagrostis canadensis (3)
   Maianthemum canadense (1)
   Petasites palmatus (1)
   Galium boreale (1)
   Pyrola asarifolia (1)
   Actaea rubra (+)
   Epilobium angustifolium (+)
   Orthilia secunda (+)

D. *Hylocomium splendens* (20)
   Pleurozium schreberi (12)
   Ptilium crista-castrensis (11)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic to subhygric (4–5)

pH REGIME (MEAN):
Humus: 3.2–6.0 (5.0)
Mineral: 3.9–7.7 (5.6)

ELEVATION RANGE (MEAN):
575–1060 (831) m

PERCENT SLOPE GRADIENT (MEAN): 0–37 (4)

ASPECT: Variable (level to northerly)

SOIL SUBGROUPS: Orthic, Gleyed, and Brunisolic Gray Luvisols

ASSOCIATED SOIL UNIT/ASSOCIATION: BKM, DVS, DON, EDS, LDG, LDM, NMP, SIP, TRC

SOIL DRAINAGE: Moderately well to imperfectly

LANDFORM: Morainal, lacustrine

PRODUCTIVITY:

MAI (MEAN):
2.1–6.7 (4.8) m³/ha/yr

SI at 70 (MEAN): Sw 14–21 (19) m
PI 19–31 (23) m

NUMBER OF PLOTS: 15

SUCCESSIONAL RELATIONSHIPS

These forests are successionally mature. *Abies* sp. may form a significant component of stands over 100 years. Some of the forests may have succeeded from aspen forests (e.g., Sw/*Viburnum*/*Aralia*, aspen facies) over a period of 50 to 100 years.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sw/*Viburnum*/*Rubus pubescens* association, which is somewhat drier. Stands with sparse shrub and herb cover may be transitional to the Sw/*Hylocomium* association. It is similar to the *Picea glauca*/*Viburnum edule*/*Rubus pubescens* association of Archibald et al. (1984).

COMMENTS:

When the forest cover is harvested, vegetation cover (especially *Calamagrostis canadensis*) may be expected to increase greatly, competing with tree seedlings.

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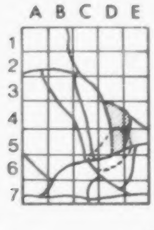
[1] + indicates less than 0.5% cover.

LBC 5b

***Sw/Viburnum/Aralia*, pine facies**
(lodgepole pine/mooseberry/wild sarsaparilla)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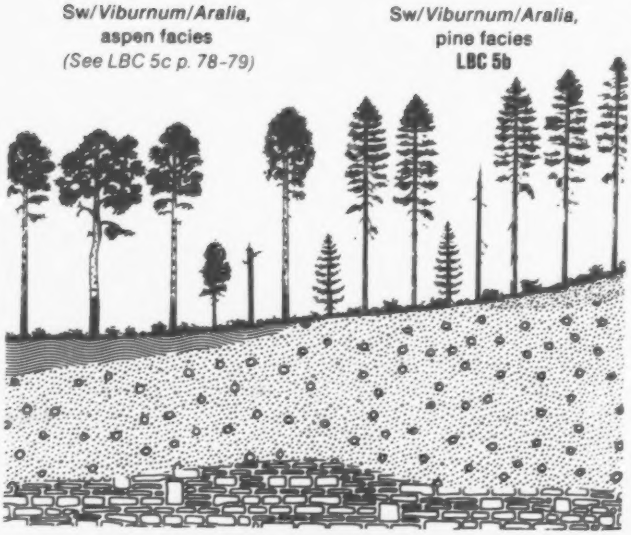
Sw/*Viburnum/Aralia*, aspen facies
(See LBC 5c p. 78-79)
Sw/*Viburnum/Aralia*, pine facies
LBC 5b

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	M-H	M-H	M-H	Sw, Pl	Br, C		M-H	↑ *Calamagrostis*, forbs, shrubs	H	M	H

Sw/*Viburnum*/*Aralia*, pine facies

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (42)
Picea glauca (5)

B. *Viburnum edule* (5)
Spiraea betulifolia (2)
Rosa acicularis (1)
Lonicera involucrata (1)
Sorbus scopulina (+)[1]

C. *Cornus canadensis* (10)
Aralia nudicaulis (9)
Gymnocarpium dryopteris (5)
Linnaea borealis (4)
Arnica cordifolia (3)
Maianthemum canadense (2)
Epilobium angustifolium (2)
Rubus pubescens (1)
Pyrola asarifolia (1)
Calamagrostis canadensis (1)
Lycopodium annotinum (1)
Aster conspicuus (1)
Petasites palmatus (+)
Orthilia secunda (+)
Streptopus amplexifolius (+)

D. *Pleurozium schreberi* (22)
Hylocomium splendens (8)
Ptilium crista-castrensis (5)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Mesic (4)

pH REGIME (MEAN):
Humus: 4.1-5.0 (4.6)
Mineral: 3.9-5.6 (5.2)

ELEVATION RANGE (MEAN): 780-1060 (920) m

PERCENT SLOPE GRADIENT (MEAN): 2-22 (11)

ASPECT: North to west

SOIL SUBGROUPS: Brunisolic and Orthic Gray Luvisols, Eluviated Eutric Brunisols

ASSOCIATED SOIL UNIT/ASSOCIATION: BKM, COP (MSK), EDS, HRT, LDG, LDM, TOR, TRC

SOIL DRAINAGE: Moderately well to well

LANDFORM: Morainal

PRODUCTIVITY:

MAI (MEAN):
3.0-5.9 (4.2) m^3/ha/yr

SI at 70 (MEAN): Pl 16-28 (21) m
Sw 15-22 (19) m

NUMBER OF PLOTS: 11

SUCCESSIONAL RELATIONSHIPS:

These forests are successionally quite stable, but gradual replacement of pine by spruce may occur over long time periods. These pine forests have a fire origin.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sw/*Viburnum*/*Rubus pubescens* association, pine facies, which is somewhat drier and has less *Aralia* cover and more *Rubus pubescens*. It corresponds to the *Pinus contorta*/*Viburnum edule*/*Aralia nudicaulis* association of Archibald et al. (1984). Stands with sparse shrub and herb cover and a significant spruce component may be transitional to the Sw/*Hylocomium* association.

COMMENTS:

When the trees are removed, competing vegetation (especially *Calamagrostis canadensis*) may be expected to increase greatly, competing with tree seedlings.

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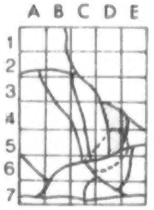
[1] + indicates less than 0.5% cover.

Sw/*Viburnum/Aralia*, aspen facies
(aspen/mooseberry/wild sarsaparilla)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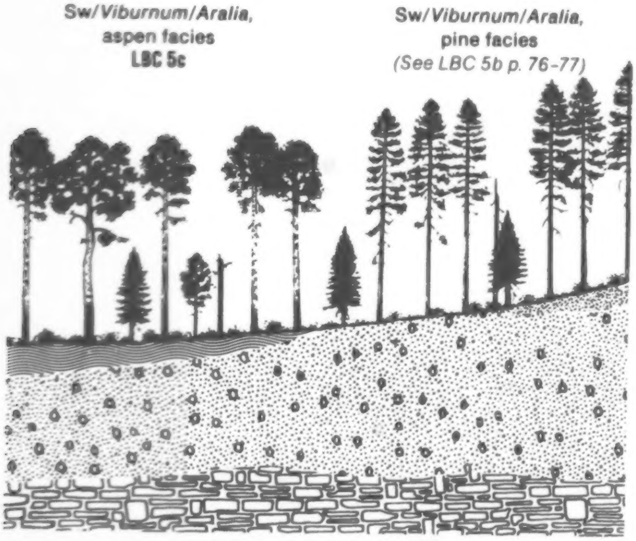
Sw/*Viburnum/Aralia*,
aspen facies
LBC 5c
Sw/*Viburnum/Aralia*,
pine facies
(See LBC 5b p. 76-77)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	M-H	M-H	M-H	Sw, Pl	BR, C	↑	M-H	↑	H	M	H

aspen, *Calamagrostis*, forbs, shrubs
excess moisture on some sites

Sw/*Viburnum*/*Aralia*, aspen facies

CHARACTERISTIC SPECIES:
(with % cover)

A. *Populus tremuloides* (47)
Picea glauca (11)

B. *Viburnum edule* (16)
Rosa acicularis (6)
Lonicera involucrata (5)
Amelanchier alnifolia (1)
Ribes lacustre (1)

C. *Aralia nudicaulis* (9)
Cornus canadensis (8)
Calamagrostis canadensis (8)
Linnaea borealis (7)
Lathyrus ochroleucus (4)
Mertensia paniculata (3)
Mitella nuda (3)
Epilobium angustifolium (2)
Pyrola asarifolia (2)
Petasites palmatus (1)
Maianthemum canadense (1)
Aster ciliolatus (1)
Smilacina racemosa (1)
Galium boreale (1)
Actaea rubra (+)[1]
Streptopus amplexifolius (+)

D. *Hylocomium splendens* (13)
Pleurozium schreberi (9)
Ptilium crista-castrensis (5)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Mesic (4)

pH REGIME (MEAN):
Humus: 4.0-6.5 (5.3)
Mineral: 4.1-6.0 (5.2)

ELEVATION RANGE (MEAN): 520–1050 (880) m

PERCENT SLOPE GRADIENT (MEAN): 0–25 (5)

ASPECT: Variable

SOIL SUBGROUPS: Orthic, Gleyed, Brunisolic, and Dark Gray Luvisols, Orthic Luvic Gleysols

ASSOCIATED SOIL UNIT/ ASSOCIATION: BKM, DON, DVS, EDS, ESH, LDG, LDM, NMP, TRC

SOIL DRAINAGE: Imperfectly to well

LANDFORM: Morainal, lacustrine

PRODUCTIVITY:

MAI (MEAN):
4.0-6.4 (5.6) m³/ha/yr

SI at 70 (MEAN): At 21–29 (23) m
Sw 17–29 (21) m
Pl 22–29 (25) m

NUMBER OF PLOTS: 19

SUCCESSIONAL RELATIONSHIPS:

These forests generally have a fire origin and should eventually succeed to white spruce (Sw/*Viburnum*/*Aralia*) in 100 to 150 years.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sw/*Viburnum*/*Rubus pubescens* association, aspen facies, which is somewhat drier and has less *Aralia* cover and more *Rubus pubescens*. It corresponds to the *Populus tremuloides*/*Viburnum edule*/*Aralia nudicaulis* association of Archibald et al. (1984).

COMMENTS:

When the aspen is removed, aspen suckers and *Calamagrostis canadensis* cover can be expected to increase dramatically, competing with planted conifer seedlings. Trees planted on such sites would probably benefit from vegetation control measures.

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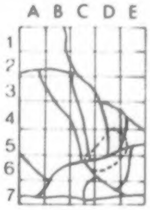
[1] + indicates less than 0.5% cover.

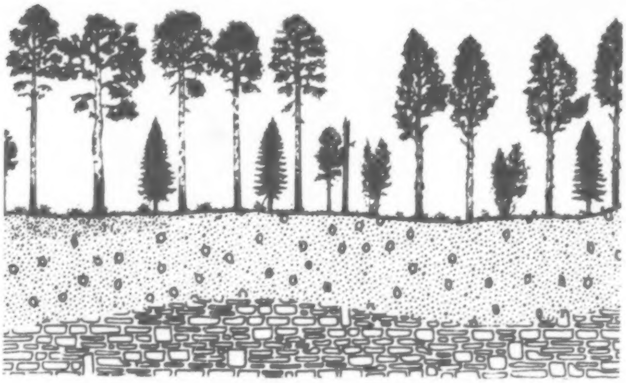
LBC 5d

Sw/*Viburnum*/*Aralia*, birch facies
(paper birch/mooseberry/wild sarsaparilla)



Sw/*Viburnum*/*Aralia*,
aspen facies
(See LBC 5c p. 78-79)

Sw/*Viburnum*/*Aralia*,
birch facies
LBC 5d



MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	M-H	M-H	M-H	Sw, Pl	BR, C	↑	M-H	↑	H	M	H

↑ birch, *Calamagrostis*, forbs, shrubs
excess moisture on some sites

Sw/*Viburnum*/*Aralia*, birch facies

CHARACTERISTIC SPECIES:
(with % cover)

A. *Betula papyrifera* (57)
   Picea glauca (3)

B. *Viburnum edule* (14)
   Rosa acicularis (9)
   Ribes lacustre (1)
   Rubus idaeus (1)
   Ribes triste (1)

C. *Aralia nudicaulis* (56)
   Calamagrostis canadensis (12)
   Cornus canadensis (7)
   Rubus pubescens (7)
   Linnaea borealis (7)
   Mitella nuda (3)
   Mertensia paniculata (1)
   Galium trifidum (1)
   Epilobium angustifolium (1)

D. *Cladonia conicraea* (5)
   Brachythecium salebrosum (4)
   Ptilium crista-castrennsis (3)
   Pleurozium schreberi (2)
   Hylocomium splendens (1)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Mesic (4)

pH REGIME (MEAN):
Humus: 4.9–6.0 (5.5)
Mineral: 4.1–4.6 (4.4)

ELEVATION RANGE (MEAN): 520–1000 (780) m

PERCENT SLOPE GRADIENT (MEAN): 0–8 (4)

ASPECT: Variable

SOIL SUBGROUPS: Orthic, Gleyed, and Dark Gray Luvisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: DON, DVS, EDS, LDG, NMP, TRC

SOIL DRAINAGE: Imperfectly to well

LANDFORM: Morainal, lacustrine

PRODUCTIVITY:

MAI: No data

SI at 70 (MEAN): Bi — No data
Sw 12-29 (21) m

NUMBER OF PLOTS: 3

SUCCESSIONAL RELATIONSHIPS:

These forests generally have a fire origin and should succeed to white spruce (Sw/*Viburnum*/*Aralia*) in 100 to 150 years.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sw/*Viburnum*/*Rubus pubescens* association, although a birch facies is not described for it. The description above includes plots from the Boreal Mixedwood Ecoregion.

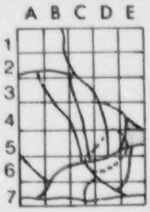
COMMENTS:

When the birch is removed, birch suckers and *Calamagrostis canadensis* cover can be expected to increase dramatically, competing with conifer seedlings. Trees planted on such sites would probably benefit from vegetation control measures.

LBC 6

Sw/Cornus stolonifera/Aralia

(white spruce/red osier dogwood/wild sarsaparilla)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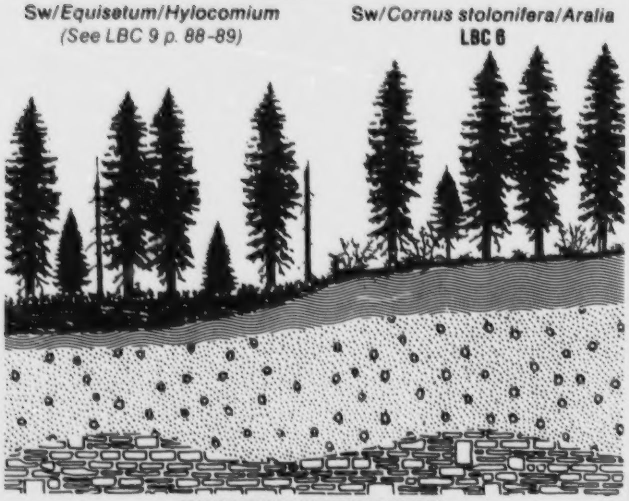

Sw/Equisetum/Hylocomium
(See LBC 9 p. 88–89)
Sw/Cornus stolonifera/Aralia
LBC 6

MANAGEMENT INTERPRETATIONS

	Season of Harvest	Logging Method	Site Preparation Intensity	Soil Compaction Hazard	Soil Puddling Hazard	Soil Water Erosion Hazard	Reforestation: Species Selection	Reforestation: Method	Reforestation: Limitations	Reforestation: Frost Heave Hazard	Vegetational Competition: Type	Vegetational Competition: Severity	Windthrow Hazard	Snowshoe Hare Damage Hazard
FLUVIAL SITES	A	CC	L	L	L	H	Sw	BR	↑ excess moisture	M-H	↑ forbs, shrubs	H	M-H	H
LACUSTRINE AND MORAINAL SITES	W	CC	M	M-H	M-H	M-H	Sw	BR	↑ excess moisture	M-H	↑ forbs, shrubs	H	M-H	H

Sw/*Cornus stolonifera*/*Aralia*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea glauca* (38)

B. *Cornus stolonifera* (16)
  Rosa acicularis (11)
  Viburnum edule (8)
  Symphoricarpus albus (2)
  Lonicera involucrata (2)

C. *Aralia nudicaulis* (15)
  Equisetum arvense (7)
  Cornus canadensis (6)
  Rubus pubescens (5)
  Linnaea borealis (3)
  Petasites palmatus (3)
  Fragaria virginiana (3)
  Smilacina stellata (2)
  Mertensia paniculata (2)
  Maianthemum canadense (2)
  Galium boreale (1)
  Actaea rubra (1)
  Orthilia secunda (1)

D. *Hylocomium splendens* (3)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Mesic to subhygric (4–5)

pH REGIME (MEAN):
Humus: 5.0–7.5 (5.9)
Mineral: 5.5–6.8 (6.1)

ELEVATION RANGE (MEAN): 760–950 (830) m

PERCENT SLOPE GRADIENT (MEAN): 0–21 (4)

ASPECT: Flat to variable

SOIL SUBGROUPS: Orthic Regosols, Orthic Humic and Humic Luvic Gleysols

ASSOCIATED SOIL UNIT/ ASSOCIATION: DON, GOS (ETH), GUN, IOS (AV), SIP, SKY, TRC

SOIL DRAINAGE: Moderately well to poorly

LANDFORM: Mostly fluvial, some morainal and lacustrine

PRODUCTIVITY:

MAI: No data

SI at 70 (MEAN): Sw 16–26 (19) m

NUMBER OF PLOTS: 8

SUCCESSIONAL RELATIONSHIPS:

These forests usually develop on recent alluvium and may in many cases appear to succeed from *Populus balsamifera*-dominated forests (balsam poplar facies) over a 50–100 year period.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sw/*Viburnum*/*Aralia* association but occurs on somewhat moister soils and on mainly fluvial landforms. It has some affinities to the *Populus tremuloides*/*Lonicera involucrata*/*Rubus pubescens* association of Archibald et al. (1984).

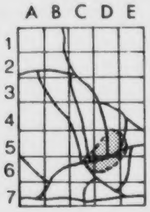
COMMENTS:

These sites can be very productive if soil drainage is not too restricted. Young plantations on these sites may be subject to damage by flooding. Two phases are recognized.

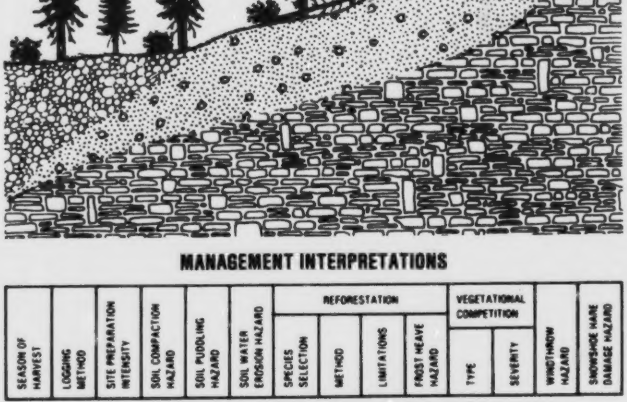
LBC 7

Sw/Oplopanax/Gymnocarpium

(white spruce/devil's-club/oak fern)



Sw/Oplopanax/Gymnocarpium
LBC 7



MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	M-H	M-H	M-H	Sw, Pl	BR, C	↑ excess moisture on some sites	M-H	↑ forbs, shrubs	H	M	H

Sw/Oplopanax/Gymnocarpium

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea glauca* (25)
   Betula papyrifera (1)

B. *Oplopanax horridum* (8)
   Viburnum edule (6)
   Lonicera involucrata (6)
   Rosa acicularis (2)
   Vaccinium membranaceum (2)
   Sorbus scopulina (1)
   Ribes lacustre (1)
   Rubus idaeus (1)
   Abies balsamea (1)

C. *Aralia nudicaulis* (12)
   Gymnocarpium dryopteris (10)
   Lycopodium annotinum (10)
   Cornus canadensis (9)
   Rubus pedatus (7)
   Linnaea borealis (5)
   Orthilia secunda (4)
   Rubus pubescens (3)
   Mertensia paniculata (3)
   Mitella nuda (3)
   Epilobium angustifolium (2)
   Smilacina racemosa (2)
   Maianthemum canadense (1)
   Petasites palmatus (1)
   Equisetum sylvaticum (1)

D. *Ptilium crista-castrensis* (22)
   Hylocomium splendens (19)
   Pleurozium schreberi (18)
   Dicranum fuscescens (1)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Subhygric (5)

pH REGIME (MEAN):
Humus: 3.9–5.2 (4.2)
Mineral: 4.3–5.6 (4.7)

ELEVATION RANGE (MEAN):
800–1200 (1000) m

PERCENT SLOPE GRADIENT (MEAN): 0–25 (6)

ASPECT: Variable

SOIL SUBGROUPS: Brunisolic, Gleyed, and Orthic Gray Luvisols

ASSOCIATED SOIL UNIT/ASSOCIATION: BKM, EDS, MBN

SOIL DRAINAGE: Imperfectly to moderately well

LANDFORM: Predominantly morainal

PRODUCTIVITY:

MAI (MEAN):
2.6–6.9 (5.1) m³/ha/yr

SI at 70 (MEAN): Sw 17–27 (23) m
Pl 18–26 (22) m
F 18–25 (22) m

NUMBER OF PLOTS: 14

SUCCESSIONAL RELATIONSHIPS:

Picea glauca and *Abies* are the successionally stable species, but some stands are dominated by *Pinus contorta* or *Betula papyrifera*. Average stand age sampled is 100 years.

SIMILAR ASSOCIATIONS:

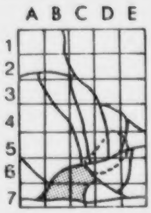
This association is similar to the Sw/*Viburnum/Aralia* association.

COMMENTS:

There are indications that all ecosystems in this association are supplied with moving seepage water at some time during the growing season.

LBC 8

Sb/*Ledum*/*Equisetum*
(black spruce/Labrador tea/horsetail)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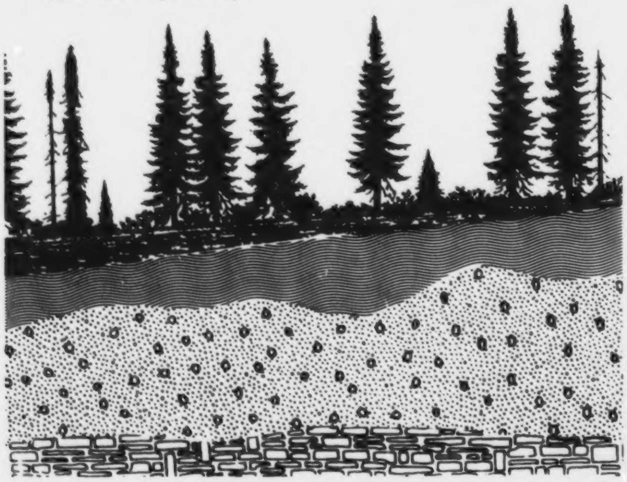
Sb/*Ledum*/*Rubus chamaemorus*
(See LBC 11 p. 92-93)
Sb/*Ledum*/*Equisetum*
LBC 8

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	H	H	H	H	Sb, Sw	BR	excess moisture	H	sedge forbs, *Calamagrostis*	H	H	M

Sb/Ledum/Equisetum

CHARACTERISTIC SPECIES:
[with % cover]

- A. *Picea mariana* (53)
  Picea glauca (25)
- B. *Ledum groenlandicum* (13)
  Rosa acicularis (2)
  Lonicera involucrata (2)
- C. *Equisetum arvense* (22)
  Cornus canadensis (7)
  Vaccinium vitis-idaea (3)
  Linnaea borealis (3)
  Equisetum scirpoides (3)
  Petasites palmatus (2)
  Mitella nuda (2)
  Calamagrostis canadensis (2)
  Rubus pubescens (1)
  Achillea millefolium (+)[1]
- D. *Hylocomium splendens* (31)
  Pleurozium schreberi (29)
  Ptilium crista-castrensis (18)
  Peltigera aphthosa (+)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Subhygric to subhydric (hygric) (5–7(6))

pH REGIME (MEAN):
Humus: 3.7–6.6 (5.1)
Mineral: 3.9–7.3 (5.7)

ELEVATION RANGE (MEAN):
800–985 (905) m

PERCENT SLOPE GRADIENT (MEAN): 0–7 (2)

ASPECT: Level to northerly

SOIL SUBGROUPS: Orthic Gleysols, Terric Mesisols, Fibric Humisols

ASSOCIATED SOIL UNIT/ASSOCIATION: GOS (ETH), GUN, KNZ, SIP, SKY, STT, WHM

SOIL DRAINAGE: Poorly to very poorly

LANDFORM: Organic, morainal, fluvial, lacustrine

PRODUCTIVITY:

MAI (MEAN):
0.4–3.8 (2.3) m^3/ha/yr

SI at 70 (MEAN): Sb 5–13 (10) m
Sw 8–15 (12) m

NUMBER OF PLOTS: 12

SUCCESSIONAL RELATIONSHIPS:

These forests are successionally mature and usually have a fire origin.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sw/*Equisetum/Hylocomium* association and is transitional to the Sb/*Ledum/Rubus chamaemorus* association where peat depths are greater. It is included in the *Picea mariana/Hylocomium splendens* association of Archibald et al. (1984).

COMMENTS:

Productivity is low on the cold, wet soils of this association. Any forest management activities should be conducted only in winter after the ground has frozen. In many cases, the expense necessary to successfully reforest these sites may be greater than revenues derived from the original timber, which is usually of small size.

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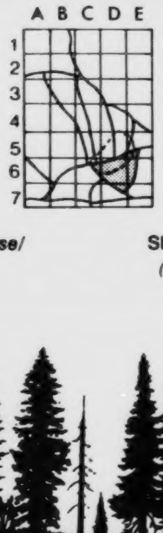
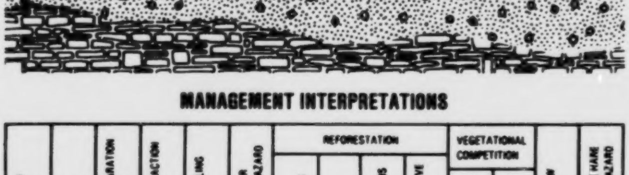
[1] + indicates less than 0.5% cover.

LBC 9

Sw/Equisetum arvense/Hylocomium
(white spruce/horsetail/feather moss)





Sw/Equisetum arvense/ Hylocomium
LBC 9

Sb/Ledum/Equisetum (See LBC 8 p. 86-87)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	H	H	H	H	Sw	BR, C	excess moisture	H	forbs, sedge	H	H	M

Sw/Equisetum arvense/Hylocomium

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea glauca* (60)
   Betula papyrifera (1)

B. *Lonicera involucrata* (3)
   Rosa acicularis (2)
   Ribes sp. (2)
   Viburnum edule (2)
   Ribes lacustre (1)

C. *Equisetum arvense* (26)
   Petasites palmatus (5)
   Linnaea borealis (4)
   Rubus pubescens (4)
   Mitella nuda (4)
   Mertensia paniculata (3)
   Galium boreale (2)
   Cornus canadensis (1)
   Fragaria virginiana (+)[1]

D. *Hylocomium splendens* (18)
   Ptilium crista-castrensis (6)
   Pleurozium schreberi (5)
   Mnium sp. (3)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Subhygric to hygric (5–6)

pH REGIME (MEAN):
Humus: 4.4–8.0 (6.2)
Mineral: 4.7–7.5 (6.3)

ELEVATION RANGE (MEAN): 670–950 (850) m

PERCENT SLOPE GRADIENT (MEAN): 0–6 (2)

ASPECT: Variable

SOIL SUBGROUPS: Orthic Humic, Orthic, and Humic Luvic Gleysols, Humic Mesisol

ASSOCIATED SOIL UNIT/ ASSOCIATION: DON, GOS (ETH), GUN, IOS (AV), SIP, SKY, STT, WHM

SOIL DRAINAGE: Poorly to very poorly

LANDFORM: Lacustrine, morainal, organic

PRODUCTIVITY:

MAI (MEAN):
1.1–5.1 (3.2) m³/ha/yr

SI at 70 (MEAN): Sw 13–25 (21) m

NUMBER OF PLOTS: 14

SUCCESSIONAL RELATIONSHIPS:

These forests are successionally mature and often the result of a very lengthy successional period, with ages often greater than 250 years.

SIMILAR ASSOCIATIONS:

This association is similar to the Sb/*Ledum/Equisetum* association but seems to occur on sites with higher pH (i.e., more alkaline). It differs from the Sw/*Equisetum pratense/Hylocomium* association by its landform and dominant *Equisetum* species. It is included in the *Picea glauca/Equisetum* spp. association of Archibald et al. (1984).

COMMENTS:

Timber volumes may often be high on these sites as a result of very old age coupled with only average annual productivity. Any forest management activities should be conducted only in winter after the ground has frozen. *Cornus stolonifera* is indicative of better sites in this association.

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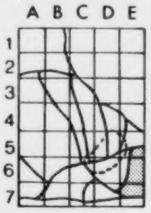
[1] + indicates less than 0.5% cover.

LBC 10

Sw/Equisetum pratense/Hylocomium
(white spruce/ meadow horsetail/feather moss)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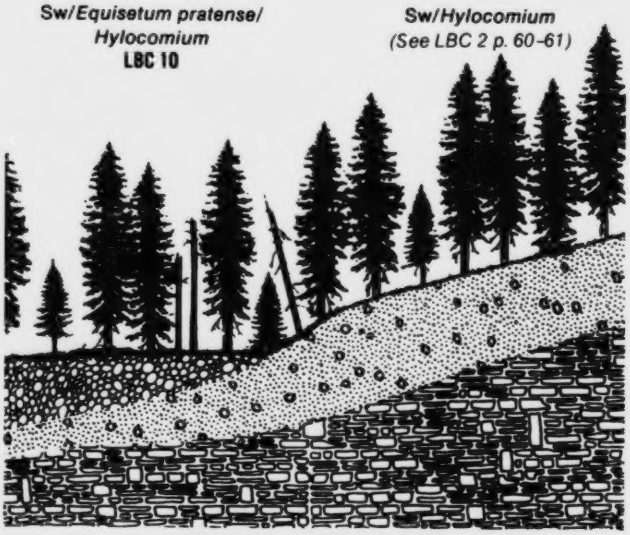

Sw/*Equisetum pratense/ Hylocomium*
LBC 10
Sw/*Hylocomium*
(See LBC 2 p. 60-61)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	L	L	H	Sw	BR	↑	H	↑	H	H	M

Calamagrostis, forbs,
excess moisture on some sites

LBC 10

Sw/*Equisetum pratense*/ *Hylocomium*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea glauca* (55)

B. *Lonicera involucrata* (5)
Rosa acicularis (3)
Viburnum edule (3)
Ribes lacustre (1)

C. *Equisetum pratense* (35)
Cornus canadensis (10)
Calamagrostis canadensis (9)
Linnaea borealis (6)
Rubus pubescens (6)
Mertensia paniculata (6)
Mitella nuda (5)
Equisetum arvense (5)
Petasites palmatus (1)
Galium boreale (+)[1]
Epilobium angustifolium (+)
Delphinium glaucum (+)
Circaea alpina[2] (+)

D. *Hylocomium splendens* (27)
Ptilium crista-castrensis (20)
Pleurozium schreberi (13)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Subhygric to hygric (5–6)

pH REGIME (MEAN):
Humus: 4.4–6.3 (5.2)
Mineral: 3.9–7.3 (5.9)

ELEVATION RANGE (MEAN): 600–1180 (920) m

PERCENT SLOPE GRADIENT (MEAN): 0–3 (1)

ASPECT: Mostly level

SOIL SUBGROUPS: Orthic and Orthic Humic Gleysols, Orthic Humic, Orthic, and Cumulic Regosols

ASSOCIATED SOIL UNIT/ ASSOCIATION: BKM, IOS (AV)

SOIL DRAINAGE: Moderately well to poorly

LANDFORM: Fluvial

PRODUCTIVITY:

MAI (MEAN):
3.2–7.5 (4.7) m³/ha/yr

SI at 70 (MEAN): Sw 11–28 (20) m
Sb 11–14 (13) m

NUMBER OF PLOTS: 12

SUCCESSIONAL RELATIONSHIPS:

These forests are successionally mature and often the result of a very lengthy succession, with ages often greater than 250 years.

SIMILAR ASSOCIATIONS:

This association is similar to the Sw/*Equisetum arvense*/ *Hylocomium* association but differs by occurring on fluvial rather than lacustrine or morainal landforms and by being dominated by *Equisetum pratense* rather than *E. arvense*. This association is common on recent floodplains along major rivers. It corresponds to the Sw/*Equisetum pratense*/ feather moss association of Robertson et al. (1984) and is included in the *Picea glauca*/ *Equisetum* spp. association of Archibald et al. (1984).

COMMENTS:

This association is one of the most productive in the study area, due in part to its enrichment by base-rich seepage water or by occasional flooding.

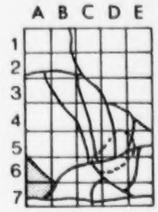
---

[1] + indicates less than 0.5% cover.

[2] Species characteristic of this association but occurring in less than 60% of the sample plots.

LBC 11

Sb/Ledum/Rubus chamaemorus
(black spruce/Labrador tea/cloudberry)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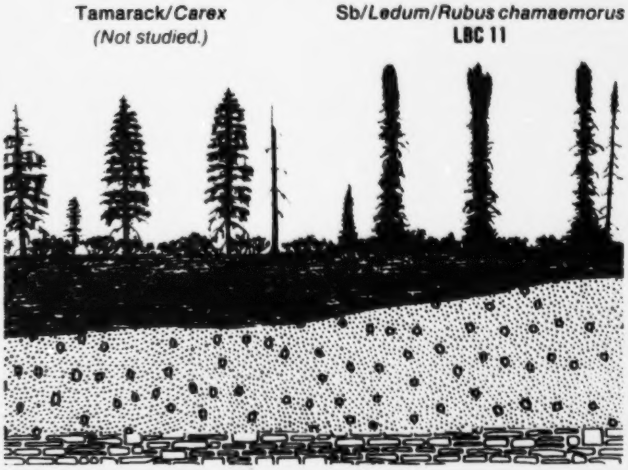

Tamarack/*Carex*
(Not studied.)
Sb/*Ledum/Rubus chamaemorus*
LBC 11

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	SC	H*	L	L	H	Sb	BR	excess moisture, cold soils	H	*Ledum*, sedge	M	H	M

* Should be accompanied by drainage measures.

LBC 11

Sb/Ledum/Rubus chamaemorus

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea mariana* (25)

B. *Ledum groenlandicum* (30)

C. *Vaccinium vitis-idaea* (7)
Rubus chamaemorus (6)
Equisetum sylvaticum (5)
Oxycoccus microcarpus (2)
Petasites palmatus (+)[1]

D. *Sphagnum* spp. (50)
Pleurozium schreberi (25)
Ptilium crista-castrensis (10)
Hylocomium splendens (5)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Subhygric to hygric (5-6)

pH REGIME (MEAN):
Humus: 2.4-6.0 (4.7)
Mineral: 4.0-5.9 (4.9)

ELEVATION RANGE (MEAN): 520-1300 (900) m

PERCENT SLOPE GRADIENT (MEAN): 0-2 (0)

ASPECT: Level

SOIL SUBGROUPS: Terric and Typic Mesisols, Fibrisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: KNZ (FKE)

SOIL DRAINAGE: Very poorly to poorly

LANDFORM: Organic

PRODUCTIVITY:

MAI (MEAN): 0.2-2.2 (1.3) m³/ha/yr

SI at 70 (MEAN): Sb 5-14 (8) m

NUMBER OF PLOTS: 17

SUCCESSIONAL RELATIONSHIPS:

This association is successionally mature, being the result of the infilling of a pond with peat deposited as vegetation dies or by the acccumulation of organic deposits in poorly drained terrain.

SIMILAR ASSOCIATIONS:

This association is most similar to the Sb/*Ledum/ Equisetum arvense* association, which occurs on shallower peat deposits, is somewhat better drained, and has higher productivity. It is anticipated that further subdivisions in the grouping could be made with additional data. It corresponds to the Sb/Labrador tea/*Sphagnum* association and has affinities to the Sb-tamarack/ Labrador tea/moss associations of Robertson et al. (1984).

COMMENTS:

These forests have very low productivity, small standing timber, and generally little commercial value. Productivity could likely be increased by drainage, but such measures are not at present economically justified.

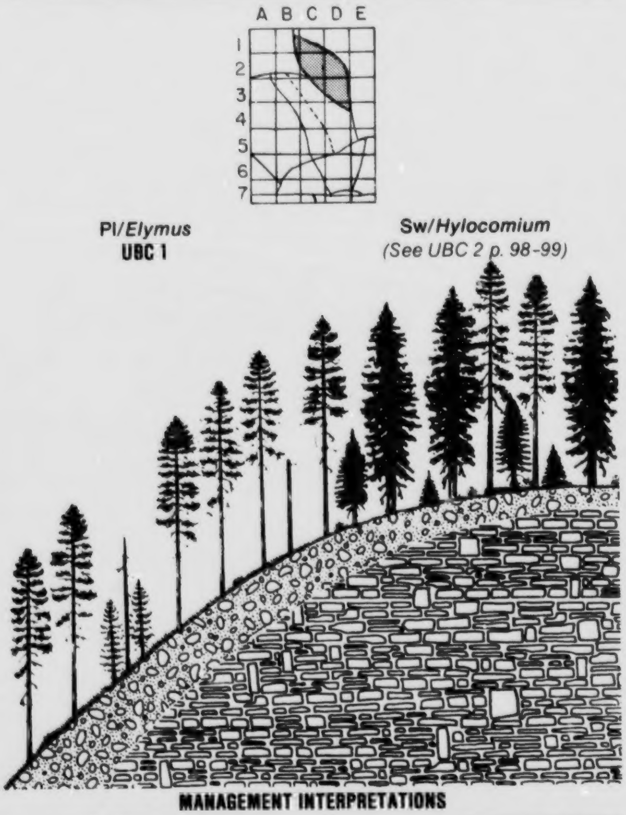
---

[1] + indicates less than 0.5% cover.

UPPER BOREAL CORDILLERAN (UBC) ECOREGION

UBC 1

Pl/*Elymus*
(lodgepole pine/hairy wild rye)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Pl/*Elymus*
UBC 1
Sw/*Hylocomium*
(See UBC 2 p. 98-99)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
A	CC	L	L	L	L	Pl	C, DS	↑ drought	L	↑ *Elymus*	L	L	L

Pl/*Elymus*[1]

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (26)

B. *Shepherdia canadensis* (5)
Rosa acicularis (4)

C. *Vaccinium vitis-idaea* (12)
Elymus innovatus (10)
Linnaea borealis (9)
Arctostaphylos uva-ursi (7)
Arnica cordifolia (4)
Cornus canadensis (3)
Vaccinium caespitosum (3)

D. *Pleurozium schreberi* (19)
Hylocomium splendens (14)
Ptilium crista-castrensis (3)
Peltigera aphthosa (1)
Cetraria halei (+)[2]

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Submesic (3)

pH REGIME (MEAN):
Humus: — (4.4)
Mineral: — (5.6)

ELEVATION RANGE (MEAN):
1250–1340 (1298) m

PERCENT SLOPE GRADIENT
(MEAN): 0–28 (14)

ASPECT: Southwesterly

SOIL SUBGROUPS: Orthic Gray Luvisols, Eluviated Eutric Brunisols

ASSOCIATED SOIL UNIT/ASSOCIATION: MLB, RBB

SOIL DRAINAGE: Rapidly to well

LANDFORM: Morainal, colluvium

PRODUCTIVITY:

MAI (MEAN):
3.1–3.6 (3.3) m³/ha/yr

SI at 70 (MEAN): Pl 14 (14) m

NUMBER OF PLOTS: 2

SUCCESSIONAL RELATIONSHIPS:

These forests have a fire origin and tend to be relatively stable, with the pine reproducing in the understory. Spruce encroachment is slow.

SIMILAR ASSOCIATIONS:

Some dry sites may be transitional to the Pl-Sb/*Ledum*/lichen association, while moister sites may be transitional to the Pl-Sb/*Ledum*/*Pleurozium* association. This association corresponds to the Pl/hairy wild rye association of Robertson et al. (1984) and is similar to the *Populus tremuloides*/*Shepherdia canadensis*/*Aster conspicuus* association of Archibald et al. (1984).

COMMENTS:

This association tends to be most prevalent in the foothills in the southwestern corner of the study area. The usually droughty soils may hinder the success of planted seedlings.

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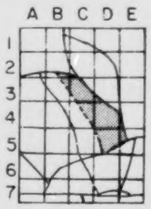
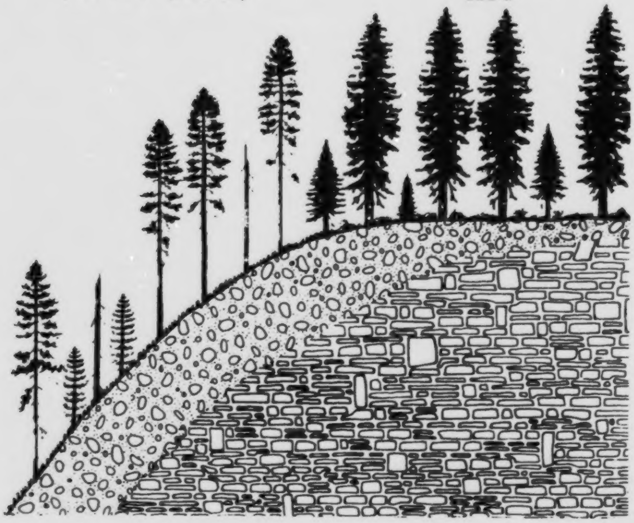
[1] Site data from Robertson et al. (1984).

[2] + indicates less than 0.5% cover.

UBC 2

Sw/Hylocomium
(white spruce/feather moss)





MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
A	CC	M	M-H	M-H	M-H	Sw, Pl	C, BR	↑	M	forbs	L	M	L-M

excess moisture on some sites

Sw/Hylocomium

CHARACTERISTIC SPECIES:
(with %cover)

A. *Picea glauca* (20)
Pinus contorta (8)
Abies sp. (4)

B. *Rosa acicularis* (2)
Viburnum edule (1)
Lonicera involucrata (1)

C. *Cornus canadensis* (9)
Linnaea borealis (6)
Lycopodium annotinum (3)
Rubus pedatus (2)
Orthilia secunda (1)
Petasites palmatus (1)
Mertensia paniculata (1)
Mitella nuda (1)
Arnica cordifolia (1)

D. *Pleurozium schreberi* (31)
Hylocomium splendens (25)
Ptilium crista-castrensis (20)
Dicranum fuscescens (1)
Peltigera aphthosa (1)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic (4)

pH REGIME (MEAN):
Humus: 3.4-5.7 (4.5)
Mineral: 3.8-6.0 (4.8)

ELEVATION RANGE (MEAN):
1000-1290 (1160) m

PERCENT SLOPE GRADIENT (MEAN): 0-35 (9)

ASPECT: Primarily northerly

SOIL SUBGROUPS: Brunisolic Gray Luvisols, Orthic and Eluviated Dystric Brunisols

ASSOCIATED SOIL UNIT/ASSOCIATION: COP (MSK), DPV, IOS (AV), JRV, RBB, SHP, TOR

SOIL DRAINAGE: Moderately well to well drained

LANDFORM: Morainal, fluvial, residual

PRODUCTIVITY:

MAI (MEAN):
2.0-5.7 (3.7) m³/ha/yr

SI at 70 (MEAN): Sw 10-19 (14) m
Sb 10-13 (11) m
Pl 13-25 (18) m
F 10-20 (15) m

NUMBER OF PLOTS: 20

SUCCESSIONAL RELATIONSHIPS:

Normally, *Picea glauca* is both the initial colonizer and dominant climax species in this ecosystem association. *Pinus contorta* is a frequent colonizer, while *Picea mariana, Populus tremuloides*, and *Populus balsamifera* are infrequent. Climax species are *Picea glauca* and *Abies balsamea* under better growing conditions, with increased *Picea mariana* under poorer conditions. Average sampled stand age is 110 years.

SIMILAR ASSOCIATIONS:

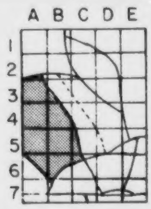
Under moister and cooler conditions, the Sw/*Hylocomium* ecosystem association grades into Pl-Sb/*Ledum/Pleurozium* or Sw-Sb/*Equisetum* ecosystem associations. This association corresponds to the Sw/*Hylocomium* association of the Lower Boreal Cordilleran Ecoregion and to the *Picea glauca/Hylocomium splendens* association of Archibald et al. (1984).

COMMENTS:

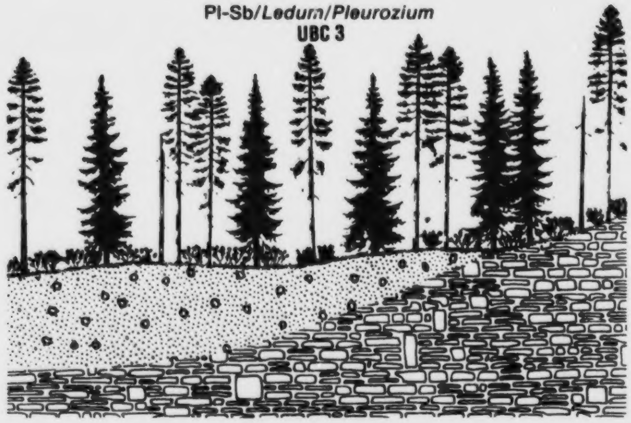
There is a wide range in the sample stands' productivity, which is a function of stand age, soil and organic matter characteristics, and stem density.

UBC 3

Pl-Sb/*Ledum*/*Pleurozium*
(lodgepole pine—black spruce/Labrador tea/feather moss)



Pl-Sb/*Ledum*/*Pleurozium*
UBC 3



MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
A	CC	L	M-H	L	M-H	Pl, Sw	C, DS		L	↑ *Elymus, Calamagrostis*	L-M	L-M	M
MEDIUM TO COARSE TEXTURED, MODERATELY WELL TO RAPIDLY DRAINED, L-H GENERALLY <10 cm													
A	CC	M	M-H	M-H	M-H	Pl, Sw	C, DS		M	↑ *Calamagrostis*	M	M	M
MODERATELY FINE TO FINE TEXTURED, IMPERFECTLY TO MODERATELY WELL DRAINED, L-H >10 cm													

Pl-Sb/*Ledum*/*Pleurozium*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (34)
Picea mariana (14)

B. *Ledum groenlandicum* (13)
Vaccinium membranaceum (4)
Vaccinium myrtilloides[1] (3)

C. *Cornus canadensis* (7)
Vaccinium vitis-idaea (5)
Linnaea borealis (2)
Lycopodium annotinum (1)

D. *Pleurozium schreberi* (44)
Ptilium crista-castrensis (14)
Hylocomium splendens (6)
Polytrichum commune[1] (1)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic (4)

pH REGIME (MEAN):
Humus: 2.9–5.0 (3.8)
Mineral: 4.1–6.8 (4.9)

ELEVATION RANGE (MEAN):
980–1460 (1190) m

PERCENT SLOPE GRADIENT (MEAN): 0–43 (7)

ASPECT: Variable

SOIL SUBGROUPS: Brunisolic and Orthic Gray Luvisols, Eluviated Eutric and Dystric Brunisols

ASSOCIATED SOIL UNIT/ASSOCIATION: COP (MSK), DPV, HRT, JUY (SMT), MBN, MLB, OBD, PZY, RBB, SHP, TOR

SOIL DRAINAGE: Mostly moderately well (well to imperfectly)

LANDFORM: Morainal, residual

PRODUCTIVITY:

MAI (MEAN):
0.6–6.3 (3.0) m³/ha/yr

SI at 70 (MEAN): Pl 9–24 (16) m
Sb 7–17 (11) m

NUMBER OF PLOTS: 66

SUCCESSIONAL RELATIONSHIPS:

These forests have a fire origin, and usually the pine and black spruce are the same age, although the spruce occupies an understory position. Very old stands (greater than 150 years) tend to be dominated by *Picea* spp. and *Abies* sp., replacing the lodgepole pine.

SIMILAR ASSOCIATIONS:

This association cannot be confused with others but is sometimes transitional to Sw/*Hylocomium* and Pl/*Alnus*. It has counterparts in the Pl-Sb/*Ledum*/*Pleurozium* association of the Lower Boreal Cordilleran Ecoregion (LBC 3), and the Pl-F/*Vaccinium—Ledum*/*Pleurozium* association of the Subalpine Ecoregion (SA 3). It corresponds to the Pl-Sb/Labrador tea/*Vaccinium* spp. association of Robertson et al. (1984) and includes several associations of Archibald et al. (1984): *Pinus contorta*/*Ledum groenlandicum*/*Pleurozium schreberi*, *Pinus contorta*/*Ledum groenlandicum—Vaccinium membranaceum*, and *Picea mariana—Pinus contorta*/*Ledum groenlandicum—Vaccinium membranaceum*.

COMMENTS:

This association is the most extensive in the study area. There is considerable variability in the relative abundance of the dominant species, stem density, and humus layer thickness, which have a large influence upon stand productivity. Managed stands would be expected to have a productivity range much narrower than that given above. Soil type, which varies somewhat, will influence the management of these sites. Two phases are recognized.

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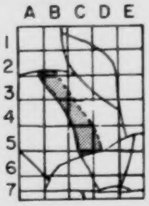
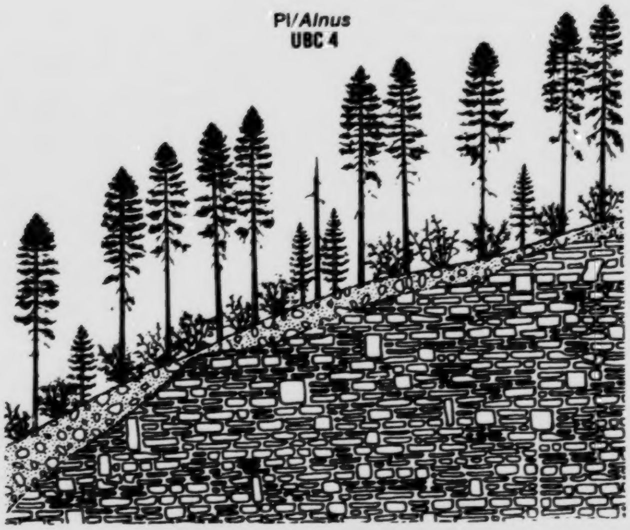
[1] Species characteristic of the association but occurring in less than 60% of the sample plots.

UBC 4

Pl/*Alnus*
(lodgepole pine/alder)



Pl/*Alnus*
UBC 4



MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
A	CC	M	M-H	M-H	M-H	Pl, Sw	C, BR		M	↑ *Calamagrostis*, shrubs	M	L-M	M

UBC 4

Pl/*Alnus*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (28)

B. *Alnus crispa* (33)
  Ledum groenlandicum (4)
  Vaccinium membranaceum (3)
  Rosa acicularis (2)
  Viburnum edule (2)
  Lonicera involucrata (1)

C. *Cornus canadensis* (7)
  Linnaea borealis (5)
  Vaccinium vitis-idaea (4)
  Lycopodium annotinum (4)
  Arnica cordifolia (3)
  Rubus pubescens (3)
  Calamagrostis canadensis (3)
  Petasites palmatus (2)
  Epilobium angustifolium (2)
  Pyrola asarifolia (1)

D. *Pleurozium schreberi* (25)
  Ptilium crista-castrensis (17)
  Hylocomium splendens (10)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic to subhygric (4–5)

pH REGIME (MEAN):
Humus: 3.5–5.6 (4.5)
Mineral: 3.9–6.6 (4.8)

ELEVATION RANGE (MEAN):
930–1370 (1130) m

PERCENT SLOPE GRADIENT (MEAN): 0–20 (5)

ASPECT: Variable

SOIL SUBGROUPS: Orthic and Brunisolic Gray Luvisols, Orthic Eutric Brunisols, ELuviated Dystric Brunisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: COP (MSK), DPV, EDS, HRT, JUY (SMT), LDG, OBD, TOR

SOIL DRAINAGE: Moderately well to poorly

LANDFORM: Morainal, residual

PRODUCTIVITY:

MAI (MEAN):
2.3–5.6 (4.3) m^3/ha/yr

SI at 70 (MEAN): Pl 15–25 (20) m
Sw 17–23 (18) m

NUMBER OF PLOTS: 28

SUCCESSIONAL RELATIONSHIPS:

The characteristics of stable forests belonging to this association are unknown. *Picea glauca, P. mariana*, and *Abies* would likely be components of stands that have not suffered major disturbance for several centuries. Such conditions were not found in the study area.

SIMILAR ASSOCIATIONS:

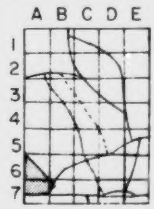
This association is similar to the Pl-Sb/*Ledum/Pleurozium* association to which it is often transitional. It is also similar to the Sw/*Hylocomium* association. It corresponds to the *Pinus contorta—Alnus crispa—Arnica cordifolia* association of Kojima (1984) and to the Pl/alder/feather moss association of Robertson et al. (1984). It includes the *Pinus contorta/Alnus crispa/Rubus pubescens* and *Pinus contorta/ Alnus crispa/Ledum groenlandicum* associations of Archibald et al. (1984) and has affinities to the A-Pl/alder/ sarsaparilla and the Sw/ alder/feather moss associations of Robertson et al. (1984).

COMMENTS:

This is the most productive lodgepole pine-dominated association in the study area, probably due at least in part to the nitrogen-fixing abilities of *Alnus*. In some situations, the *Alnus* appears to be competing with tree seedlings as well as providing habitat for rodents.

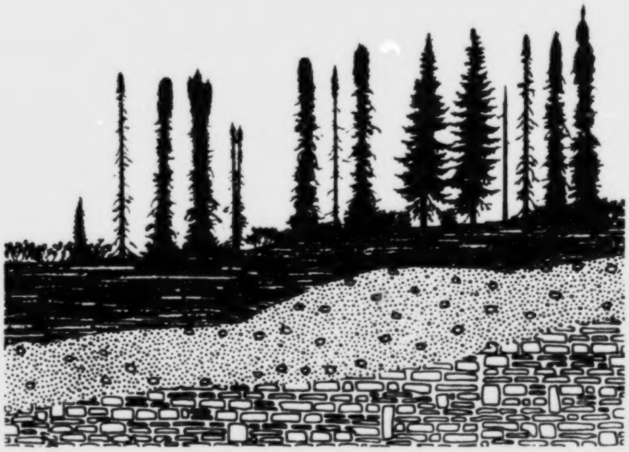
UBC 5

Sb/*Ledum/Rubus chamaemorus*
(black spruce/Labrador tea/cloudberry)



Sb/*Ledum/Rubus chamaemorus*
UBC 5

Sb/*Ledum/Equisetum*
(See UBC 6 p. 106-107)



MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	SC	H*	L	L	H	Sb	BR	↑ excess moisture, cold soils	H	↑ *Ledum*, sedge	M	H	M

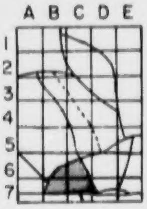
*Should be accompanied by drainage measures.

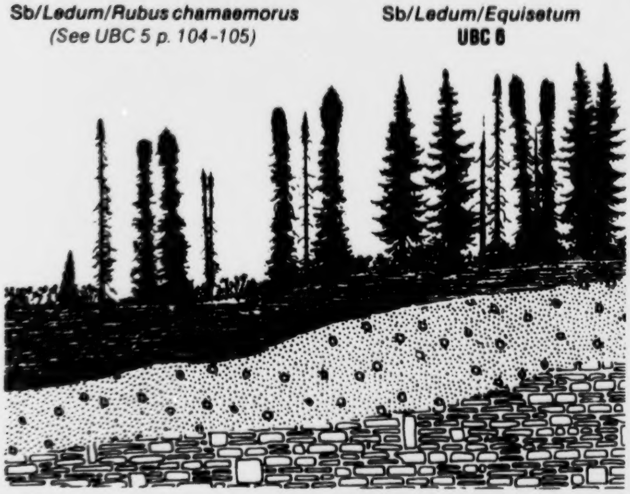
Sb/*Ledum*/*Rubus chamaemorus*

Data for this association are few and are included in the corresponding ecosystem association described for the Lower Boreal Cordilleran Ecoregion (LBC 11), on pages 92-93.

UBC 6

Sb/Ledum/Equisetum
(black spruce/Labrador tea/horsetail)




Sb/Ledum/Rubus chamaemorus
(See UBC 5 p. 104-105)
Sb/Ledum/Equisetum
UBC 6

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	H	H	H	H	Sb, Sw	BR	↑	H	↑	M	H	M

sedge, forbs, *Calamagrostis*
excess moisture, cold soils

Sb/*Ledum*/*Equisetum*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea mariana* (37)
   Pinus contorta (3)

B. *Ledum groenlandicum* (12)
   Lonicera involucrata (3)
   Rosa acicularis (2)

C. *Equisetum sylvaticum* (7)
   Vaccinium vitis-idaea (6)
   Cornus canadensis (5)
   Equisetum arvense (4)
   Linnaea borealis (3)
   Equisetum scirpoides (3)
   Mertensia paniculata (2)
   Petasites palmatus (1)
   Mitella nuda (1)
   Calamagrostis canadensis (1)
   Achillea millefolium (+)[1]
   Galium boreale (+)

D. *Pleurozium schreberi* (27)
   Ptilium crista-castrensis (26)
   Hylocomium splendens (21)
   Peltigera aphthosa (1)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Hygric (6)

pH REGIME (MEAN):
Humus: 3.5–5.8 (5.0)
Mineral: 4.9–6.9 (6.0)

ELEVATION RANGE (MEAN):
1000–1290 (1096) m

PERCENT SLOPE GRADIENT (MEAN): 0–23 (5)

ASPECT: Variable

SOIL SUBGROUPS: Orthic, Humic, and Luvic Gleysols, Terric Humisols

ASSOCIATED SOIL UNIT/ASSOCIATION: KNZ (FKE), SKY, STT

SOIL DRAINAGE: Poorly to very poorly

LANDFORM: Morainal, lacustrine, organic

PRODUCTIVITY:

MAI (MEAN):
1.1–3.7 (2.2) m^3/ha/yr

SI at 70 (MEAN): Sb 7–16 (11) m

NUMBER OF PLOTS: 15

SUCCESSIONAL RELATIONSHIPS:

These forests are successionally mature, with most being 130–160 years old. The older average age of the sampled stands indicates that fire frequency is lower in these forests than in more mesic stands.

SIMILAR ASSOCIATIONS:

This ecosystem association is similar to the Sw/*Equisetum arvense*/*Hylocomium* association and often occurs in proximity to the Sb/*Ledum*/*Rubus chamaemorus* association where peat depths are greater. Productivity is, however, poorer in the black spruce forests. This association is also common in the Lower Boreal Cordilleran Ecoregion (LBC 8). It is included in the *Picea mariana*/*Equisetum* spp./*Sphagnum* spp. association of Archibald et al. (1984).

COMMENTS:

Any forest management activities should be conducted only in winter after the ground has frozen. Reforestation expenses may be greater than revenues received from the usually small timber on these sites.

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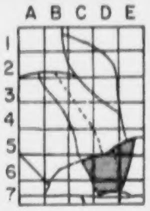
[1] + indicates less than 0.5% cover.

UBC 7

Sw/Equisetum arvense/Hylocomium
(white spruce/common horsetail/feather moss)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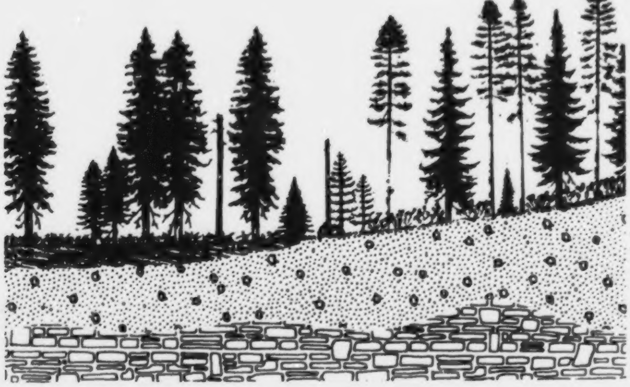
Sw/Equisetum arvense/
Hylocomium
UBC 7
Pl-Sb/Ledum/Pleurozium
(See UBC 3 p. 100-101)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	H	H	H	H	Sw	BR, C	excess moisture, cold soils	H	sedge, forbs	M-H	H	M

Sw/*Equisetum arvense*/*Hylocomium*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea glauca* (40)
   Picea mariana (15)
   Pinus contorta (+)[1]

B. *Lonicera involucrata* (4)
   Rosa acicularis (3)
   Ledum groenlandicum (+)
   Ribes lacustre (+)
   Ribes triste (+)

C. *Equisetum arvense* (13)
   Cornus canadensis (11)
   Equisetum pratense (10)
   Mitella nuda (3)
   Linnaea borealis (3)
   Mertensia paniculata (3)
   Rubus pubescens (2)
   Calamagrostis canadensis (2)
   Vaccinium vitis-idaea (1)
   Galium boreale (1)
   Petasites palmatus (1)
   Equisetum scirpoides (+)
   Achillea millefolium (+)

D. *Ptilium crista-castrensis* (34)
   Hylocomium splendens (25)
   Pleurozium schreberi (12)
   Dicranum fuscescens (+)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Subhygric to hygric (5–6)

pH REGIME (MEAN):
Humus: 4.6–5.9 (5.1)
Mineral: 6.2–6.4 (6.3)

ELEVATION RANGE (MEAN): 1020–1450 (1200) m

PERCENT SLOPE GRADIENT (MEAN): 1–7 (4)

ASPECT: Variable

SOIL SUBGROUPS: Orthic, Rego, and Rego Humic Gleysols, Terric Humisols, Gleyed Gray Luvisols

ASSOCIATED SOIL UNIT/ASSOCIATION: IOS (AV), SKY, STT

SOIL DRAINAGE: Imperfectly to very poorly

LANDFORM: Morainal, lacustrine, fluvial

PRODUCTIVITY:

MAI (MEAN): 1.1–4.3 (2.7) m^3/ha/yr

SI at 70 (MEAN): Sw 11–24 (15) m
Sb 10–13 (11) m

NUMBER OF PLOTS: 5

SUCCESSIONAL RELATIONSHIPS:

These forests are successionally mature and often the result of a very lengthy succession. Ages often are greater than 250 years.

SIMILAR ASSOCIATIONS:

This association is similar to the Sb/*Ledum*/*Equisetum* association but seems to occur on sites with higher pH (i.e., more alkaline). It differs from the Sw/*Equisetum pratense*/*Hylocomium* association of the Lower Boreal Cordilleran Ecoregion (LBC 10) by its landform and dominant *Equisetum* species. It is included in the *Picea glauca*/*Equisetum* spp. association of Archibald et al. (1984).

COMMENTS:

Timber volumes often may be high on these sites as a result of very old age coupled with only average productivity. Any forest management activities should be conducted only in winter after the ground has frozen.

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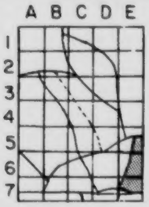
[1] + indicates less than 0.5% cover.

UBC 8

Sw/*Equisetum pratense*/*Hylocomium*
(white spruce/meadow horsetail/feather moss)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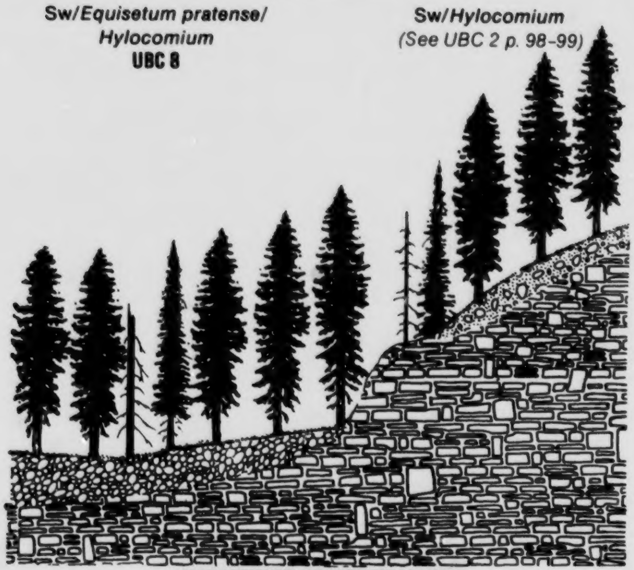

Sw/Equisetum pratense/ Hylocomium
UBC 8
Sw/Hylocomium
(See UBC 2 p. 98-99)

MANAGEMENT INTERPRETATIONS

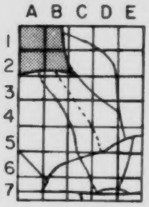
SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	M	L	L	L	H	Sw	↑ excess moisture	H	↑ *Calamagrostis*, forbs	H	H	M

Sw/*Equisetum pratense*/*Hylocomium*

Data for this association are few and are included in the corresponding ecosystem association described for the Lower Boreal Cordilleran Ecoregion (LBC 10), on pages 90-91.

UBC 9

Pl-Sb/*Ledum*/lichen
(lodgepole pine—black spruce/Labrador tea/lichen)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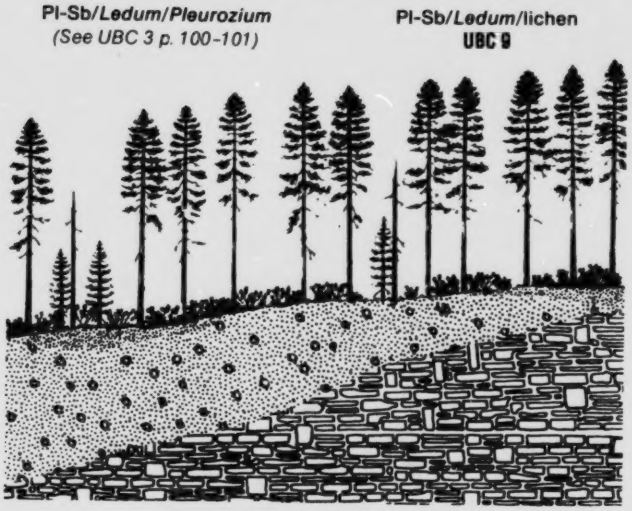

Pl-Sb/*Ledum*/*Pleurozium*
(See UBC 3 p. 100-101)
Pl-Sb/*Ledum*/lichen
UBC 9

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
A	CC	L	L	L	M	Pl	C, DS	↑ drought	L	↑ *Elymus*	L	L	L-M

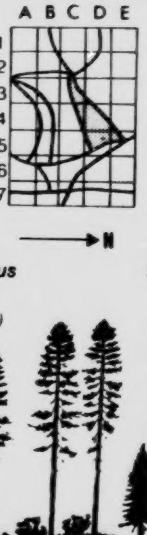
Pl-Sb/*Ledum*/lichen

Data for this association are in the corresponding ecosystem association described for the Lower Boreal Cordilleran Ecoregion (LBC 1), on pages 58-59.

SUBALPINE (SA) ECOREGION

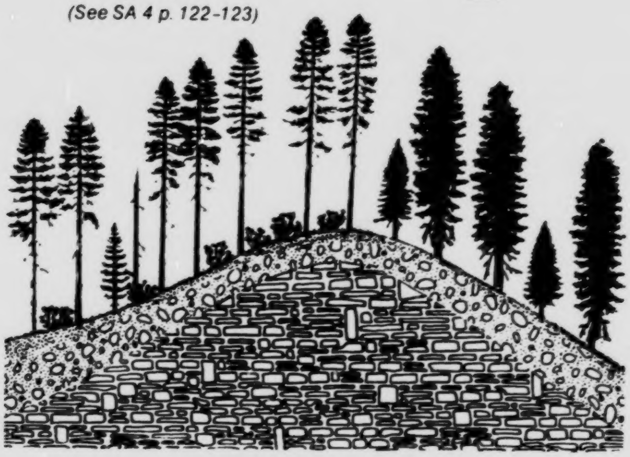
SA 1

Sx-F/*Hylocomium*
(Engelmann spruce—subalpine fir/feather moss)



Pl/*Rhododendron/Rubus pedatus*
(See SA 4 p. 122-123)

Sx-F/*Hylocomium*
SA 1



MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
A	CC	M	M	M	M	Se, Pl	C, BR	↑ short growing season	L	forbs	L	L-M	L

Sx-F/*Hylocomium*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Picea hybrid*[1] (Sx) (25)
Pinus contorta (7)
Abies sp.[2] (+)[3]

B. *Salix bebbiana* (2)
Lonicera involucrata (+)

C. *Cornus canadensis* (8)
Arnica cordifolia (7)
Linnaea borealis (5)
Mertensia paniculata (5)
Petasites palmatus (4)
Vaccinium vitis-idaea (1)
Equisetum arvense (1)
Vaccinium caespitosum (1)
Calamagrostis canadensis (+)
Epilobium angustifolium (+)
Equisetum scirpoides (+)

D. *Hylocomium splendens* (38)
Pleurozium schreberi (8)
Ptilium crista-castrensis (2)
Peltigera aphthosa (2)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic (4)

pH REGIME:
Humus: No data
Mineral: 5.8, from 1 plot

ELEVATION RANGE (MEAN):
1310-1430 (1360) m

PERCENT SLOPE GRADIENT (MEAN): 10-20 (14)

ASPECT: Variable to northerly

SOIL SUBGROUPS: Orthic and Gleyed Gray Luvisols, Eluviated Eutric Brunisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: COP (MSK), ERR, JUY (SMT), PZY, RBB, SHP

SOIL DRAINAGE: Moderately well to imperfectly

LANDFORM: Morainal veneers, residual

PRODUCTIVITY:

MAI (MEAN):
2.6-4.4 (3.5) m^3/ha/yr

SI at 70 (MEAN): Se 14-15 (14.5) m

NUMBER OF PLOTS: 3

SUCCESSIONAL RELATIONSHIPS:

These forests are successionally mature (average age of 113 years) and may succeed those first colonized by lodgepole pine, especially on northerly aspects. *Abies* can be abundant.

SIMILAR ASSOCIATIONS:

This association corresponds to the *Picea glauca/Hylocomium splendens* associations in the Lower and Upper Boreal Cordilleran ecoregions (LBC 2, UBC 2), the *Picea engelmannii/ Abies lasiocarpa—Vaccinium membranaceum*—moss association of Kojima (1984), and the *Picea engelmannii* × *glauca/ Hylocomium splendens* association of Archibald et al. (1984).

COMMENTS:

In general, productivity decreases with increasing elevation within the spruce/feather moss associations and varies greatly as a result of stand age, soil and organic matter characteristics, and stem density. Some stands may be too steep to harvest and to prepare sites using conventional equipment.

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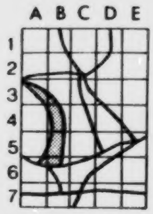
[1] Introgressive hybridization between *Picea glauca* and *Picea engelmannii* is pervasive throughout the Rockies in Alberta, which creates problems for accurate designation of individuals or stands to one or the other of the two taxa (Daubenmire 1974).

[2] No distinction is made between *Abies balsamea* and *A. lasiocarpa*.

[3] + indicates less than 0.5% cover.

SA 2

Pl/*Menziesia/Rubus pedatus*
(lodgepole pine/false azalea/five-leaved bramble)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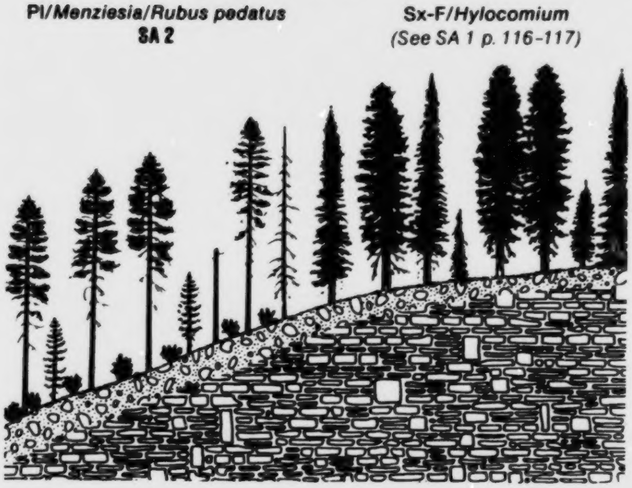
Pl/Menziesia/Rubus pedatus
SA 2
Sx-F/Hylocomium
(See SA 1 p. 116-117)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
A	CC	L-M	L-M	L-M	M	Pl, Se	C, BR	↑ short growing season	M	shrubs	L	L-M	L

Pl/Menziesia/Rubus pedatus

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (35)
   Abies sp. (4)
   Picea mariana (3)

B. *Vaccinium membranaceum* (9)
   Menziesia ferruginea (9)
   Ledum groenlandicum (4)
   Rhododendron albiflorum (2)

C. *Cornus canadensis* (4)
   Rubus pedatus (3)
   Linnaea borealis (2)
   Vaccinium vitis-idaea (2)
   Lycopodium annotinum (1)
   Arnica cordifolia (1)
   Orthilia secunda (+)[1]

D. *Pleurozium schreberi* (39)
   Ptilium crista-castrensis (5)
   Hylocomium splendens (4)
   Peltigera spp. (2)
   Polytrichum commune (1)

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic (4)

pH REGIME (MEAN):
Humus: 4.0–4.6 (4.2)
Mineral: 4.5–6.2 (5.2)

ELEVATION RANGE (MEAN):
1220–1570 (1350) m

PERCENT SLOPE GRADIENT (MEAN): 0–36 (9)

ASPECT: Northerly

SOIL SUBGROUPS: Eluviated Eutric and Dystric Brunisols, Brunisolic and Orthic Gray Luvisols

ASSOCIATED SOIL UNIT/ASSOCIATION: COP (MSK), MBN, MLB, PZY, RBB, SHP, TOR

SOIL DRAINAGE: Moderately well

LANDFORM: Morainal (Cordilleran till), colluvium

PRODUCTIVITY:

MAI (MEAN):
1.2–4.3 (2.5) m³/ha/yr

SI at 70 (MEAN): Pl 9-19 (14) m
Sw — (14) m

NUMBER OF PLOTS: 12

SUCCESSIONAL RELATIONSHIPS:

Pinus contorta is successional to *Picea* hybrid and *Abies*, but this process occurs slowly (150 years or more). Average age of the pine-dominated forests is 112 years.

SIMILAR ASSOCIATIONS:

This association is similar to the *Pinus contorta/Rhododendron albiflorum/Rubus pedatus* association but occurs on sites with generally more restricted drainage at slightly lower elevations. It is a seral stage of the Se-F/false azalea/feather moss association described by Bentz et al. (1984).

COMMENTS:

Slow growth can be expected in new stands arising after logging or fire due to the short growing season at high elevations. The *Menziesia* may be expected to compete to some extent with young tree seedlings. Some stands may be too steep to log or to prepare seedbeds for planting using conventional machinery.

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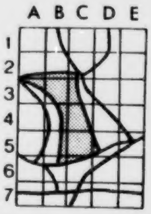
[1] + indicates less than 0.5% cover.

SA 3

Pl-F/*Vaccinium—Ledum/Pleurozium*
(lodgepole pine—fir/Labrador tea/feather moss)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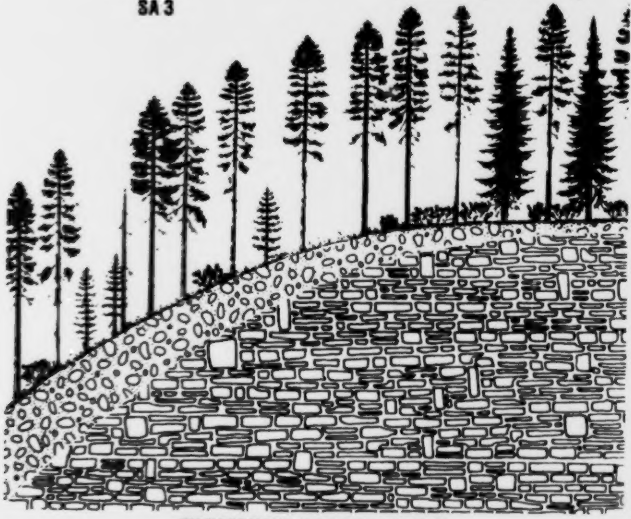
Pl-F/Vaccinium—Ledum/Pleurozium
SA 3
Pl/Menziesia/Rubus pedatus
(See SA 2 p. 118-119)

MANAGEMENT INTERPRETATIONS

						REFORESTATION				VEGETATIONAL COMPETITION			
SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY	WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
A	CC	L-M	M	M	M	Pl, Se	C, DS	↑ short growing season	M	forbs	L	L	L

Pl-F /*Vaccinium—Ledum/Pleurozium*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (34)
   Abies sp.[1] (1)

B. *Vaccinium membranaceum* (11)
   Ledum groenlandicum (5)

C. *Cornus canadensis* (5)
   Linnaea borealis (2)
   Vaccinium vitis-idaea (2)

D. *Pleurozium schreberi* (25)
   Hylocomium splendens (2)
   Ptilium crista-castrensis (1)
   Polytrichum commune[2] (+)[3]

ENVIRONMENT:

MOISTURE REGIME (MODAL):
Mesic to subhygric (4–5)

pH REGIME (MEAN):
Humus: 4.4–4.6 (4.5)
Mineral: 4.8–6.5 (5.7)

ELEVATION RANGE (MEAN):
1220–1680 (1440) m

PERCENT SLOPE GRADIENT (MEAN): 0–45 (15)

ASPECT: Variable to northerly

SOIL SUBGROUPS: Orthic and Brunisolic Gray Luvisols, Eluviated Eutric Brunisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: COP (MSK), ERR, MBN, MLB, PZY, RBB, SHP

SOIL DRAINAGE: Well to imperfectly

LANDFORM: Primarily morainal

PRODUCTIVITY:

MAI (MEAN):
0.7–5.2 (2.7) m³/ha/yr

SI at 70 (MEAN): Pl 9–22 (14) m

NUMBER OF PLOTS: 27

SUCCESSIONAL RELATIONSHIPS:

These forests have a fire origin; however, the *Abies* usually becomes established some time after the pine and occupies an understory position for much of the stand's age.

SIMILAR ASSOCIATIONS:

This association is the counterpart of the Pl-Sb/*Ledum/Pleurozium* association of the Upper Boreal Cordilleran Ecoregion (UBC 3). It corresponds to the *Picea engelmannii/Abies lasiocarpa—Vaccinium membranaceum—moss* association of Kojima (1984), the Pl-F/tall bilberry/moss association and a seral stage of the Se-F/tall bilberry/feather moss association of Bentz et al. (1984), and the *Pinus contorta/Vaccinium membranaceum/Rubus pedatus* association of Archibald et al. (1984).

COMMENTS:

There is considerable variability in the relative abundance of the dominant species, stem density, and humus layer thickness, which have a large bearing upon site productivity and its management. Managed stands would be expected to have a productivity range much narrower than that given above.

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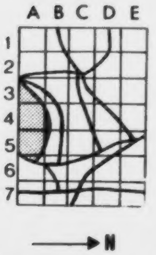
[1] Due to inconsistencies in the literature regarding taxonomic treatment of *Abies balsamea* and *Abies lasiocarpa* and to difficulties experienced in consistently recognizing the two taxa in the field, this report does not distinguish between the two species.

[2] Species characteristic of the association but occurring in less than 60% of the sample plots.

[3] + indicates less than 0.5% cover.

SA 4

Pl/*Rhododendron/Rubus pedatus*
(lodgepole pine/rhododendron/five-leaved bramble)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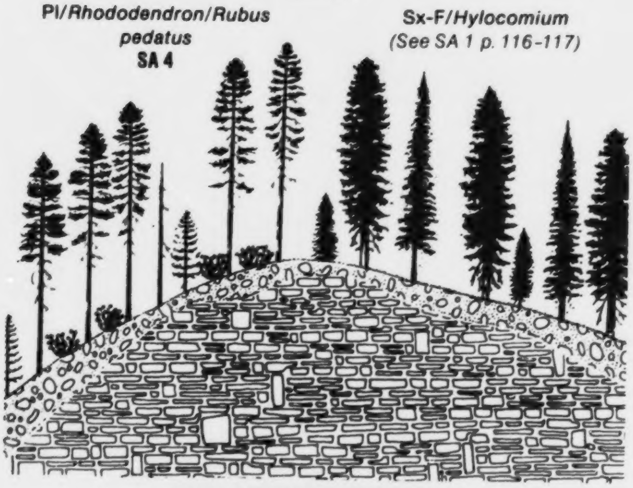

Pl/*Rhododendron/Rubus pedatus*
SA 4
Sx-F/*Hylocomium*
(See SA 1 p. 116-117)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
A	CC	L-M	L-M	L-M	M	PL, Se	C, BR	↑ short growing season	M	shrubs	L	L-M	L

SA 4

Pl/*Rhododendron*/*Rubus pedatus*

CHARACTERISTIC SPECIES:
(with % cover)

A. *Pinus contorta* (50)

B. *Rhododendron albiflorum* (27)
Vaccinium membranaceum (27)
Ledum groenlandicum (8)

C. *Cornus canadensis* (7)
Rubus pedatus (7)
Vaccinium vitis-idaea (3)
Lycopodium annotinum (1)
Linnaea borealis (1)

D. *Pleurozium schreberi* (32)
Ptilium crista-castrensis (11)
Hylocomium splendens (7)

ENVIRONMENT:

MOISTURE REGIME (MODAL): Mesic to subhygric (4-5)

pH REGIME (MEAN):
Humus: 2.9-3.6 (3.3)
Mineral: 3.5-5.2 (4.1)

ELEVATION RANGE (MEAN): 1300-1630 (1450) m

PERCENT SLOPE GRADIENT (MEAN): 2-36 (14)

ASPECT: Northerly to variable

SOIL SUBGROUPS: Eluviated Eutric Brunisols, Orthic and Brunisolic Gray Luvisols

ASSOCIATED SOIL UNIT/ ASSOCIATION: COP (MSK), MBN, MLB, PZY, RBB, SHP, TOR

SOIL DRAINAGE: Well to moderately well

LANDFORM: Morainal (Cordilleran till), colluvium

PRODUCTIVITY:

MAI (MEAN):
1.4-6.7 (3.5) m³/ha/yr

SI at 70 (MEAN): Pl 11-20 (14) m
Sw — (12) m

NUMBER OF PLOTS: 19

SUCCESSIONAL RELATIONSHIPS:

Pinus contorta is successional to a *Picea* hybrid and *Abies*, but these species are not likely to achieve dominance in less than 150 years. Average age of the pine-dominated forests is 100 years.

SIMILAR ASSOCIATIONS:

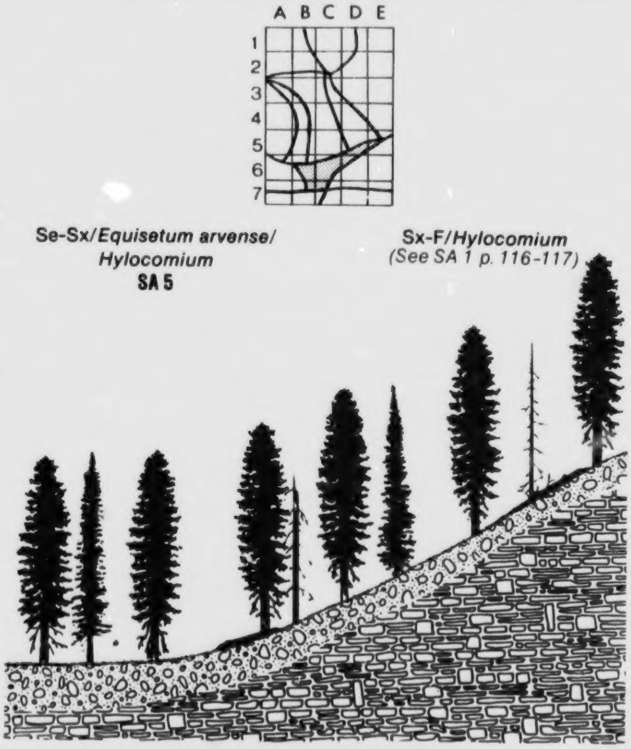
This association is similar to the *Pinus contorta/Menziesia ferruginea/ Rubus pedatus* association but occurs on generally better drained sites at slightly higher elevations. It corresponds to the *Pinus contorta—Rhododendron—Rubus pedatus* association of Kojima (1984), the *Pinus contorta/Rhododendron albiflorum/ Pleurozium schreberi* association of Archibald et al. (1984), and a seral stage of the Se-F/white-flowered rhododendron/feather moss association of Bentz et al. (1984).

COMMENTS:

Slow growth can be expected in new stands arising after logging or fire due to the short growing season at high elevations. The *Rhododendron* may be expected to compete to some extent with young tree seedlings. Some stands may be too steep to log or to prepare seedbeds for planting using conventional machinery.

SA 5

Se-Sx/*Equisetum arvense/Hylocomium*
(Engelmann spruce/common horsetail/feather moss)


A
B
C
D
E
1
2
3
4
5
6
7
Se-Sx/*Equisetum arvense/ Hylocomium*
SA 5
Sx-F/*Hylocomium*
(See SA 1 p. 116-117)

MANAGEMENT INTERPRETATIONS

SEASON OF HARVEST	LOGGING METHOD	SITE PREPARATION INTENSITY	SOIL COMPACTION HAZARD	SOIL PUDDLING HAZARD	SOIL WATER EROSION HAZARD	REFORESTATION				VEGETATIONAL COMPETITION		WINDTHROW HAZARD	SNOWSHOE HARE DAMAGE HAZARD
						SPECIES SELECTION	METHOD	LIMITATIONS	FROST HEAVE HAZARD	TYPE	SEVERITY		
W	CC	H	H	H	H	Se	Br, C	excess moisture, cold soils	H	sedge, forbs	M-H	H	M

Se-Sx/*Equisetum arvense*/*Hylocomium*

Data for this association are few, but it is similar to the Sw/*Equisetum arvense*/*Hylocomium* ecosystem association described for the Upper Boreal Cordilleran Ecoregion (UBC 7), on pages 108-109.

COMMON FOREST PLANTS OF WEST-CENTRAL ALBERTA

This section illustrates 80 common forest plant species occurring in the forest ecosystems of west-central Alberta. It accompanies and facilitates the use of the ecosystem classification and the interpretations for forest management of the area. By providing a quick visual means of identification this pictorial guide will be useful to forest workers using the field guide as well as to others wishing to familiarize themselves with some of the common forest understory species. Included are estimates of species occurrence in relation to the usual ecological moisture regime (Table 2) and nutrients (Table 3). Accompanying scales illustrate general elevation distributions of the plants. The plants illustrated in this section are typically found in the boreal forest of Alberta, including the Boreal Mixedwood, Lower and Upper Boreal Cordilleran, and closed-canopy (lower eco-subregion) Subalpine ecoregions.

The moisture and nutrient regimes and the elevation ranges for each species were derived from sample plot data from several ecological classification studies conducted in the study area, other vegetation studies reported in the literature, and the authors' experience. These environmental projections represent general conditions of occurrence rather than extreme limits.

The species have been arranged alphabetically by scientific name in seven growth form groups: **shrubs, dwarf woody plants, ferns and fern allies, forbs, grasses, sedges, lichens, and mosses**. Nomenclature follows Moss (1983) for vascular plants, Ireland et al. (1980) for mosses, and Hale and Culberson (1970) for lichens.

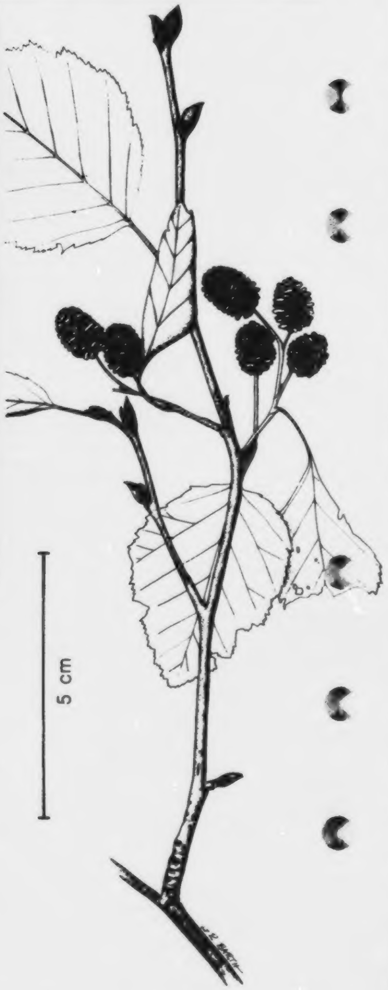
When attempting to identify a plant, examine the plant closely to note its size, growth form, color, flower and fruit characteristics, leaf size and shape, habitat, and any other distinctive features. Consult the section of the plant guide that corresponds to the growth form of the plant.

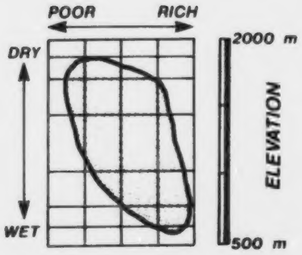
If the plant does not seem to be included in this guide, the reader may wish to consult one of the following: Comeau et al. (1982), Conard and Redfern (1979), Cormack (1977), Hale (1979), Hale and Culberson (1970), Ireland et al. (1980), Lawton (1971), Moss (1983), Porsild (1974), Scoggan (1978, 1979), and Vance et al. (1977).

An index of the scientific and usual common names for the plants illustrated here appears on page 245.

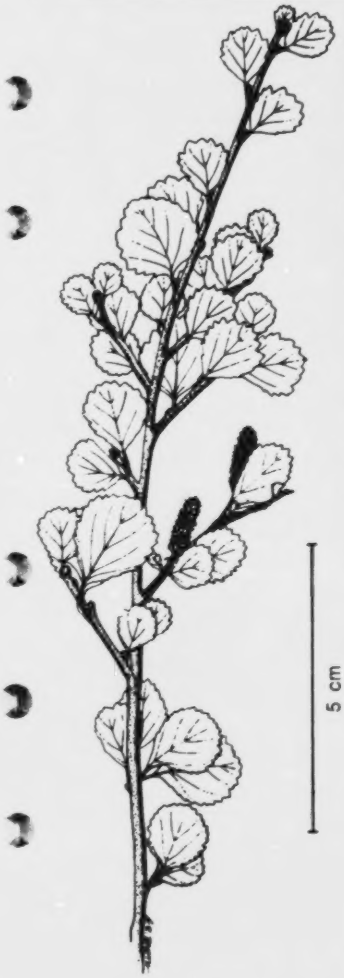
Alnus crispa
(green alder)

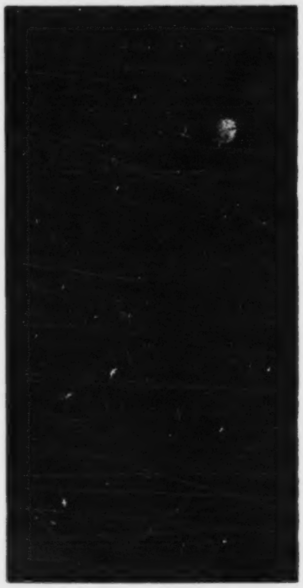
Helen Habgood



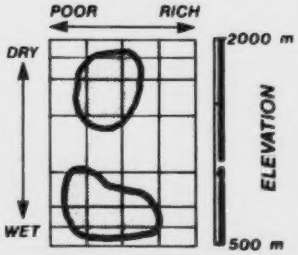


Betula glandulosa
(bog birch, dwarf birch)





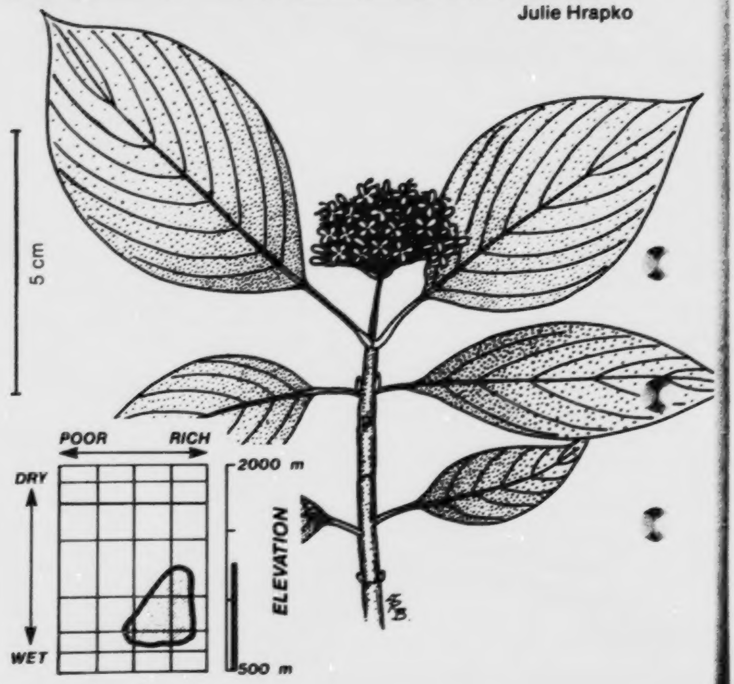
Jim Pojar



SHRUBS

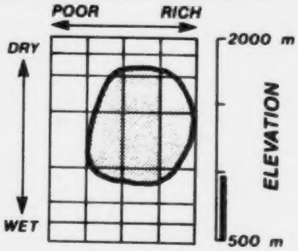
Cornus stolonifera
(red osier dogwood)

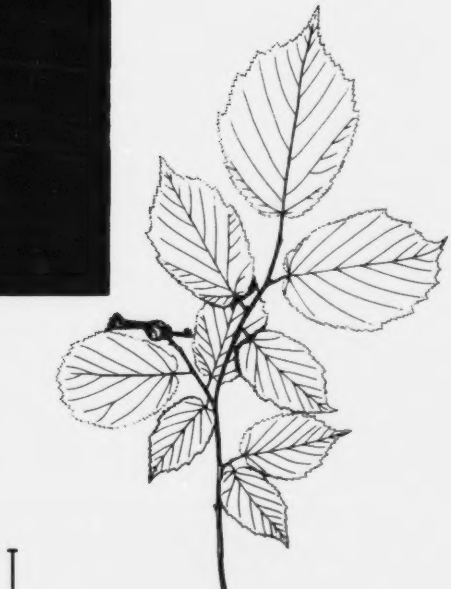
Julie Hrapko


5 cm
POOR
RICH
DRY
WET
2000 m
ELEVATION
500 m

Corylus cornuta
(beaked hazelnut)

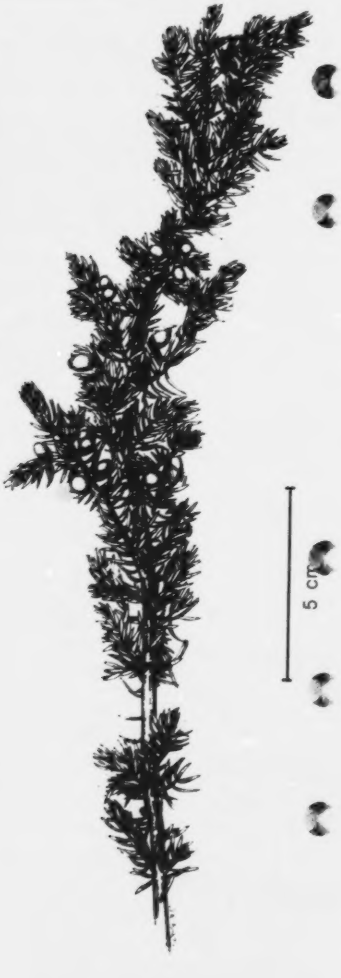
Helen Habgood

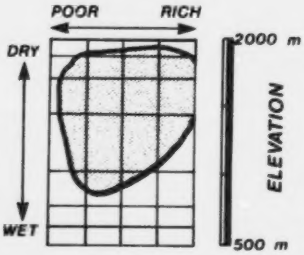




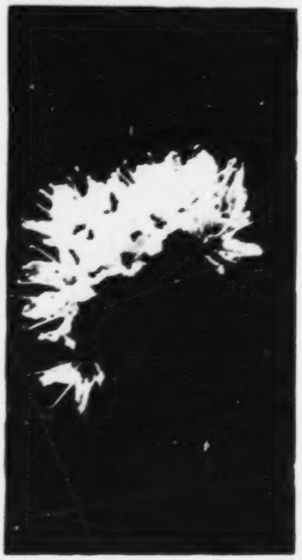
Juniperus communis
(ground juniper)

Julie Hrapko

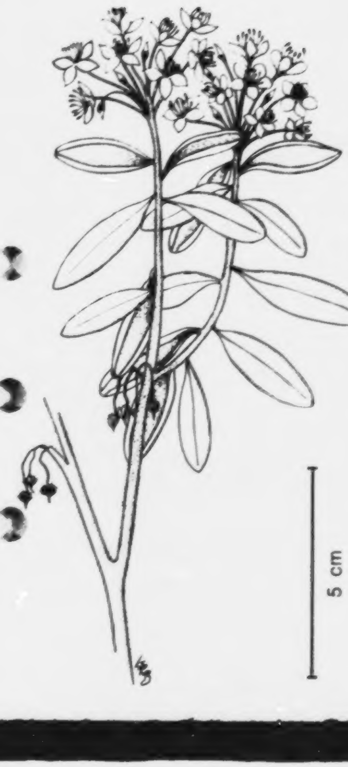


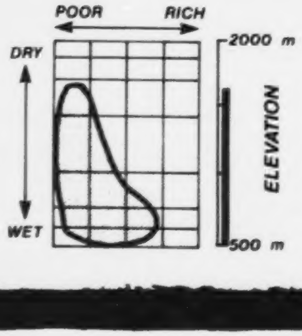


Ledum groenlandicum
(Labrador tea)

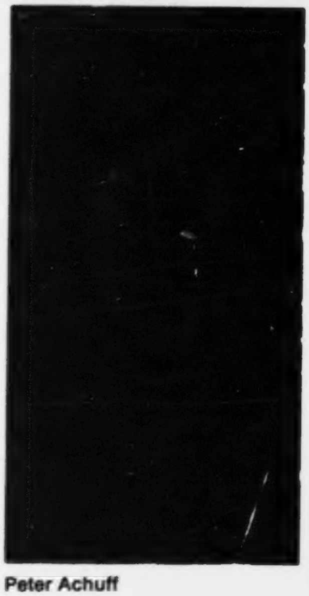


Julie Hrapko

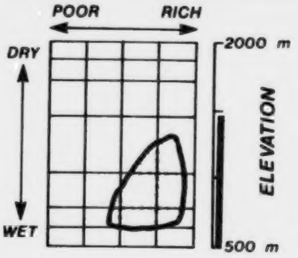


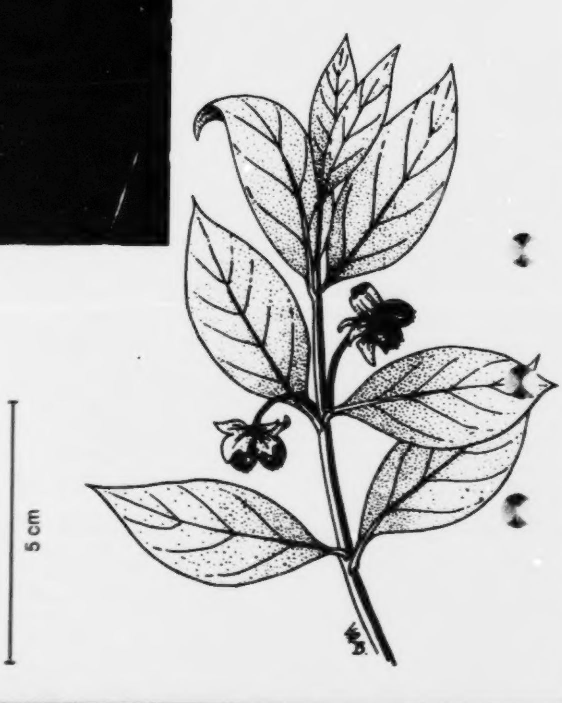


Lonicera involucrata
(bracted honeysuckle)



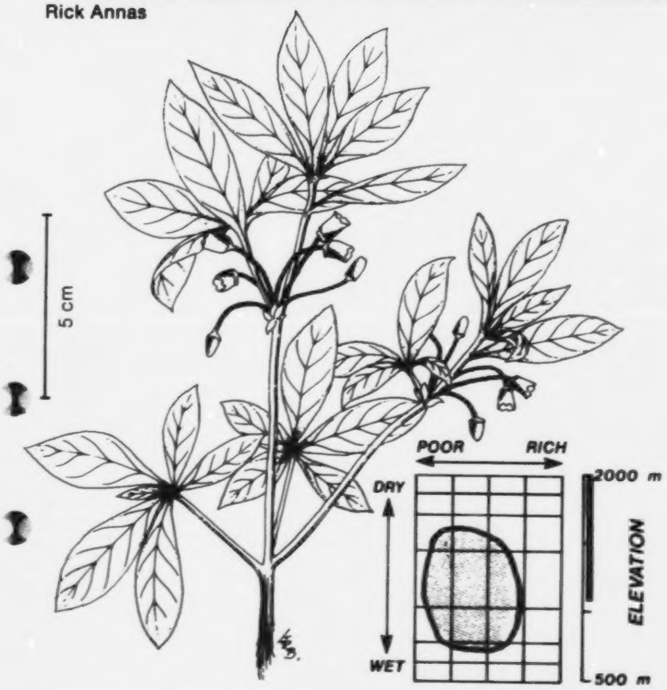
Peter Achuff



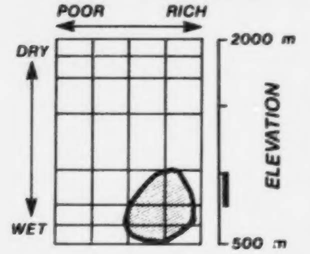


Menziesia ferruginea
(false azalea)

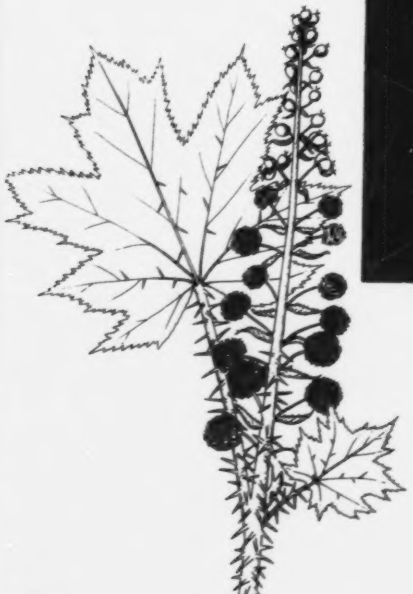
Rick Annas


5 cm
POOR
RICH
DRY
WET
2000 m
ELEVATION
500 m

Oplopanax horridum
(devil's-club)

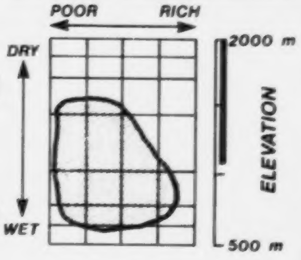


Rick Annas

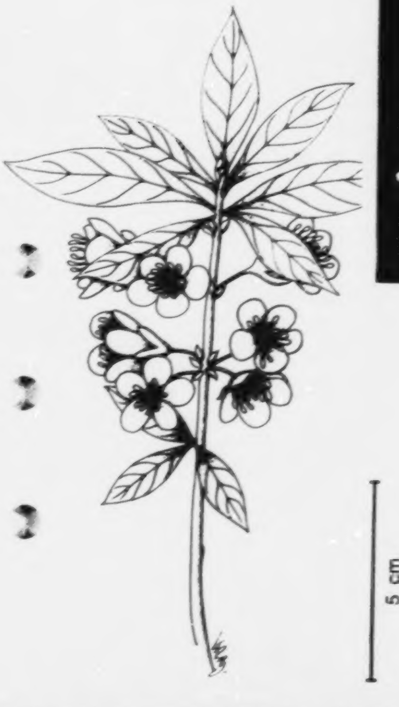


Rhododendron albiflorum

(white-flowered rhododendron)

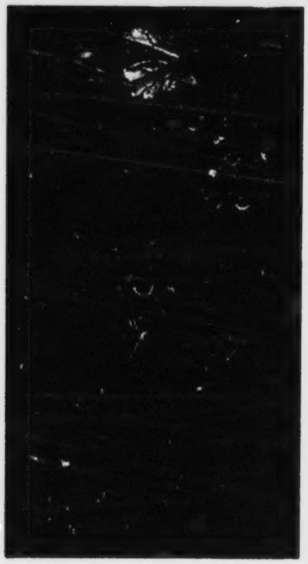


Helen Habgood

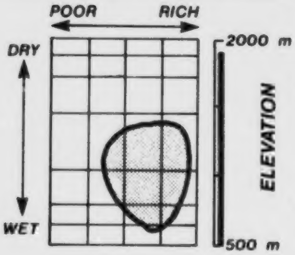


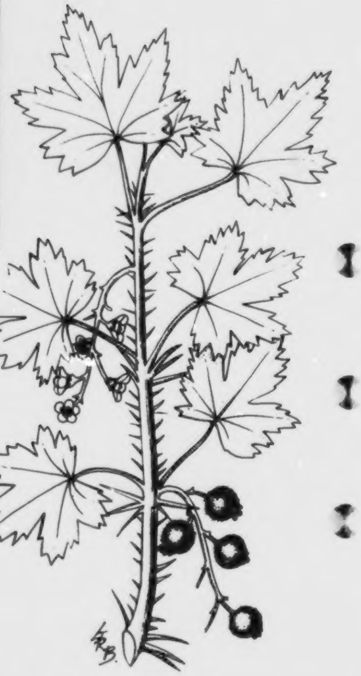
Ribes lacustre

(bristly black currant, prickly black gooseberry)

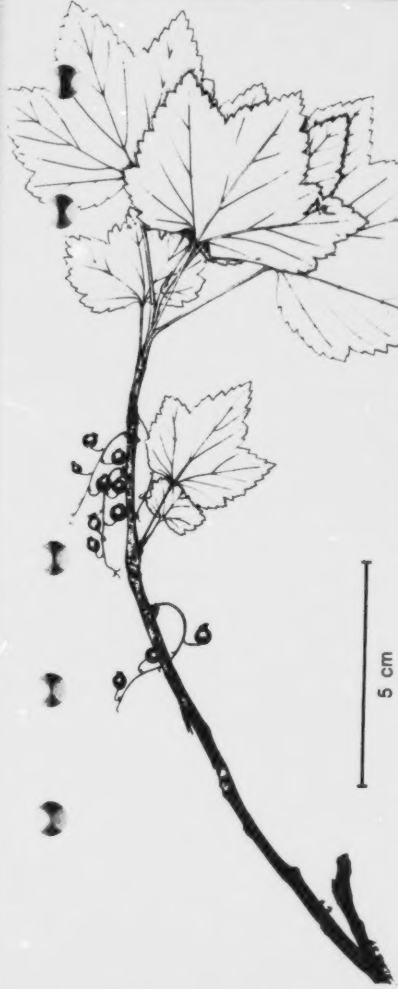


Rick Annas

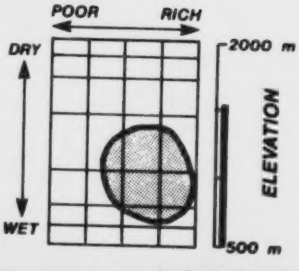




Ribes triste
(wild red currant)

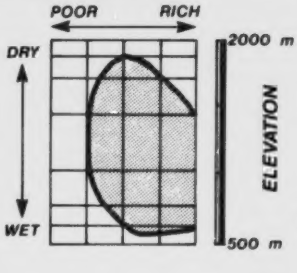


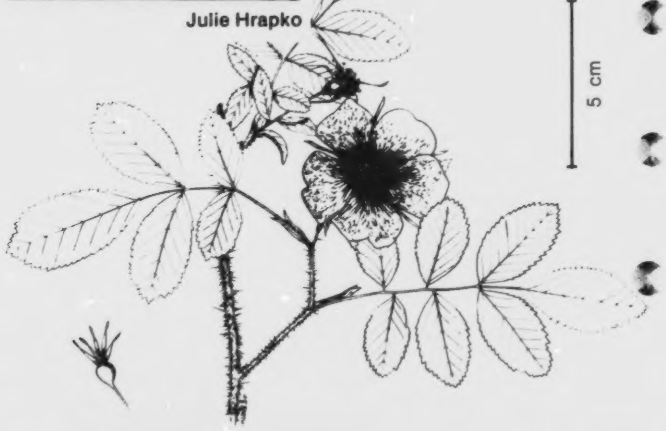
Derek Johnson



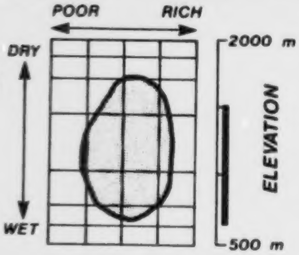
Rosa acicularis
(prickly rose)

Julie Hrapko

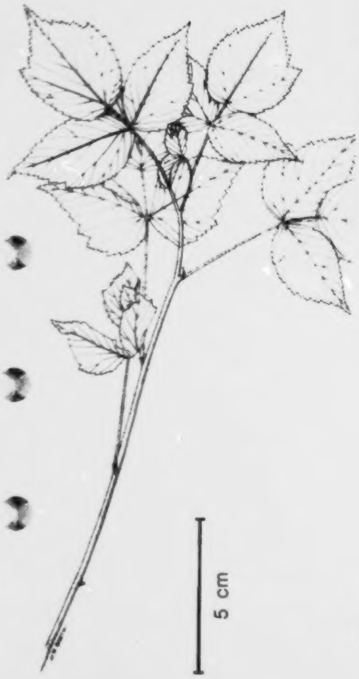


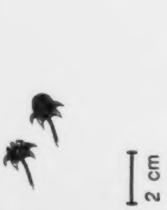


Rubus idaeus
(wild red raspberry)



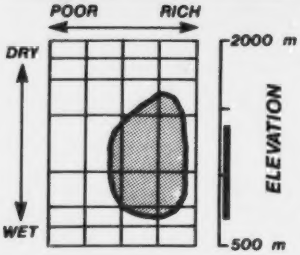
Julie Hrapko

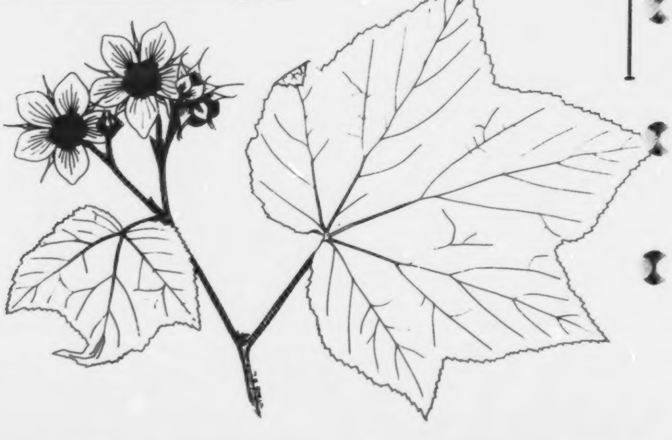




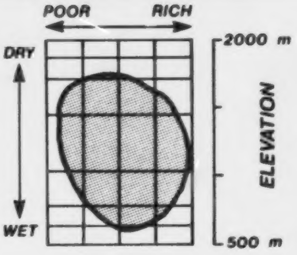
Rubus parviflorus
(thimble berry)

Julie Hrapko





Salix bebbiana
(Bebb willow)


POOR
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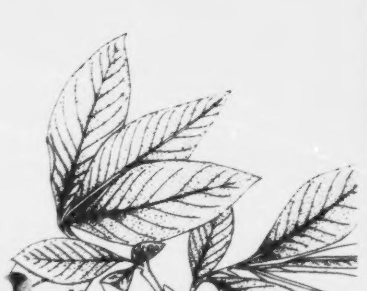
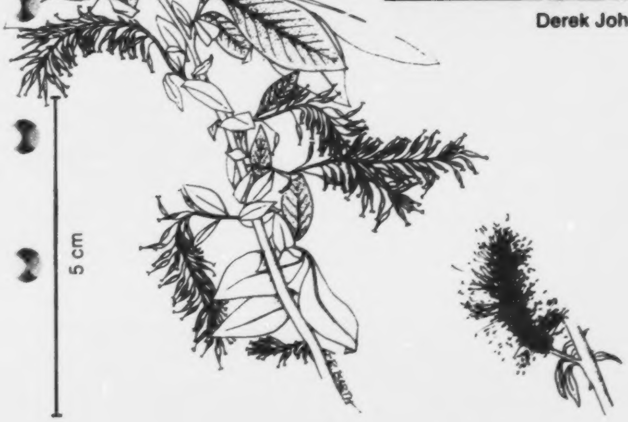
2000 m
ELEVATION
500 m

Derek Johnson

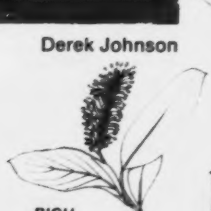


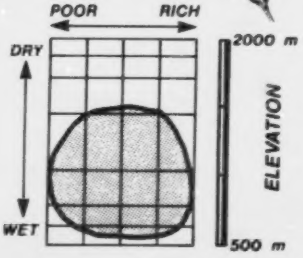


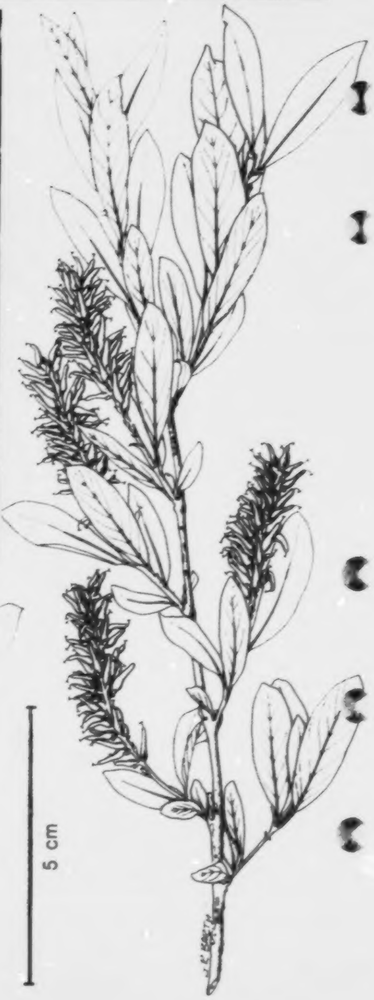
SHRUBS

Salix glauca
(gray-leaf willow)

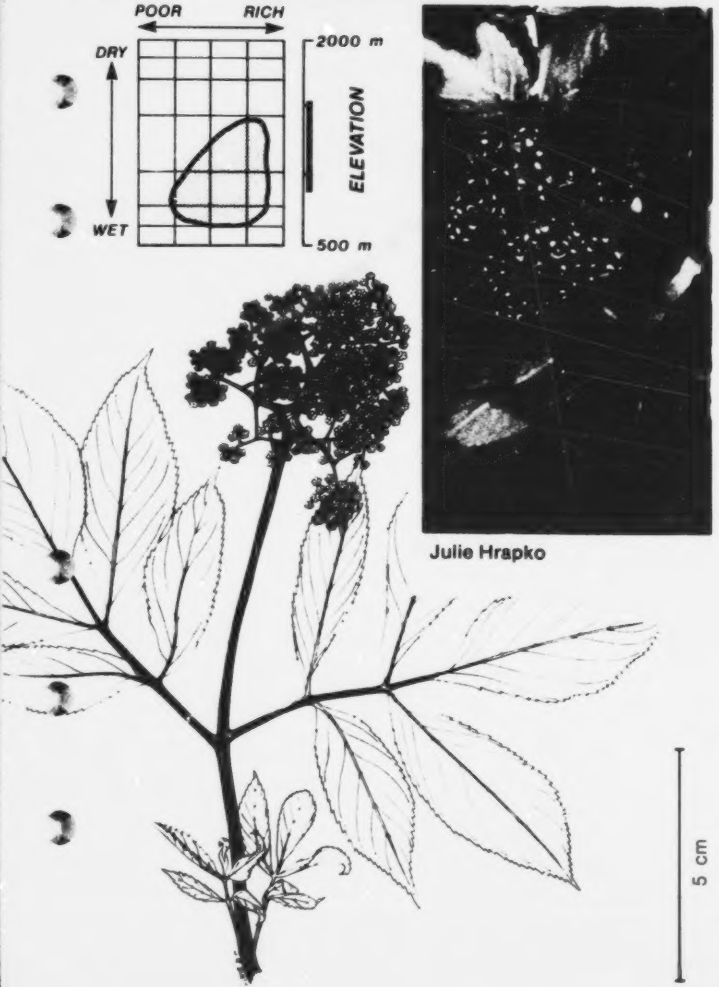
Derek Johnson







Sambucus pubens
(red elderberry)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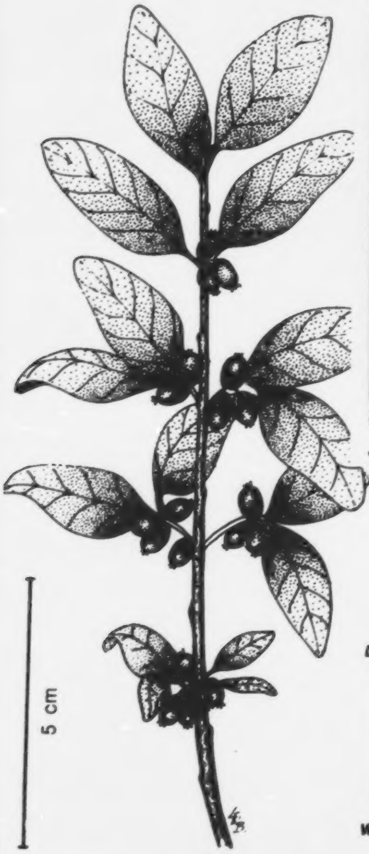
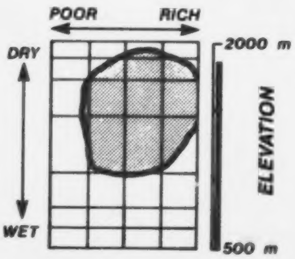
2000 m
ELEVATION
500 m
5 cm

Julie Hrapko

Shepherdia canadensis
(Canadian buffalo-berry)

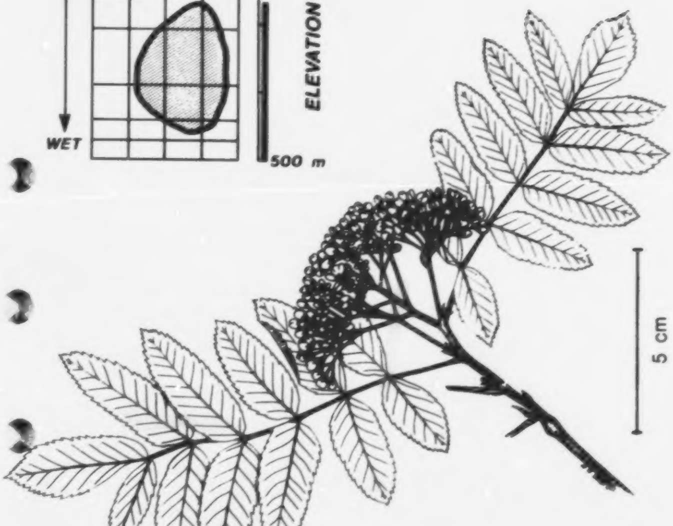


Julie Hrapko



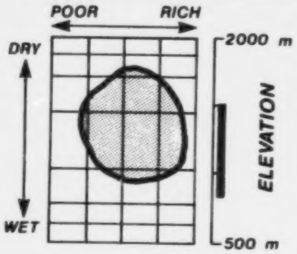
Sorbus scopulina
(mountain ash)

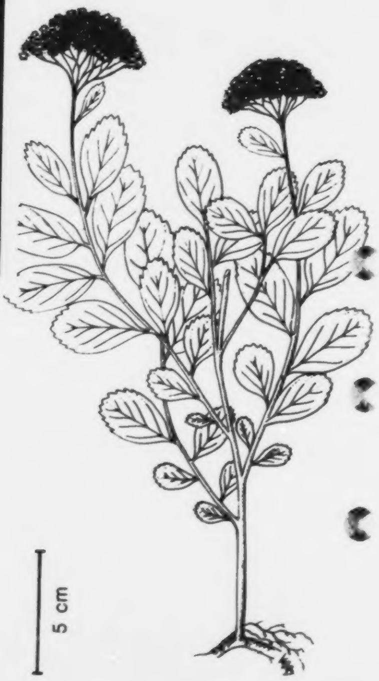
Rick Annas


POOR
RICH
DRY
WET
2000 m
ELEVATION
500 m
5 cm

Spiraea betulifolia
(white meadowsweet)

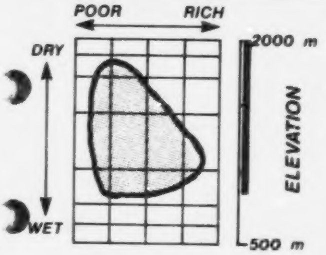
Helen Habgood



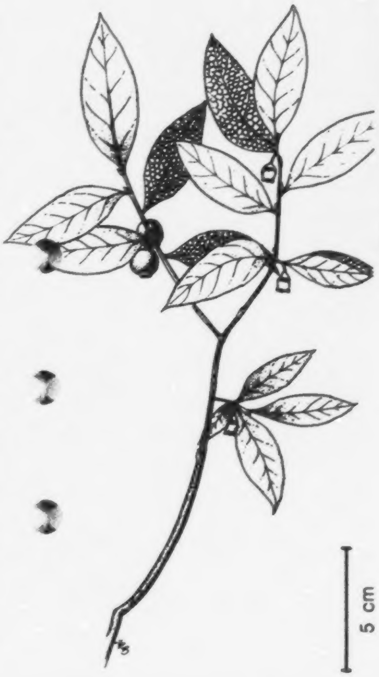


Vaccinium membranaceum

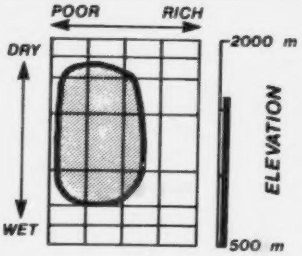
(tall bilberry)



Helen Habgood



Vaccinium myrtilloides
(blueberry)


POOR
RICH
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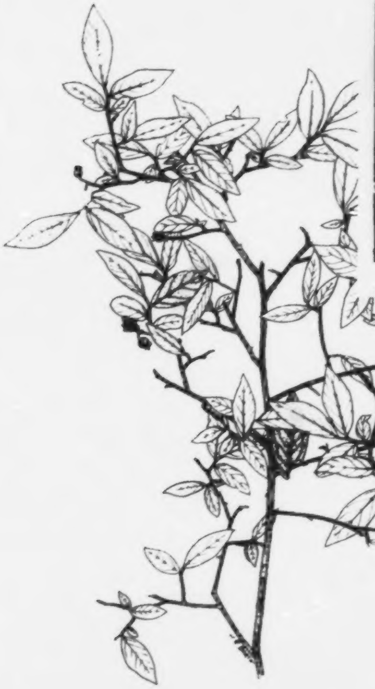
2000 m
ELEVATION
500 m

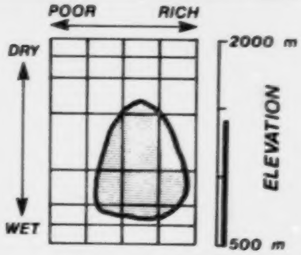
Julie Hrapko

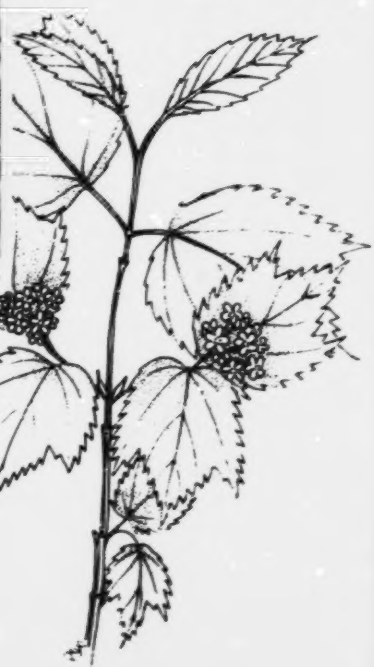


Viburnum edule

(low-bush cranberry, mooseberry)

Julie Hrapko

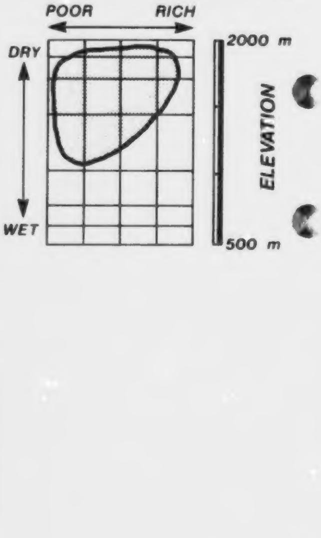


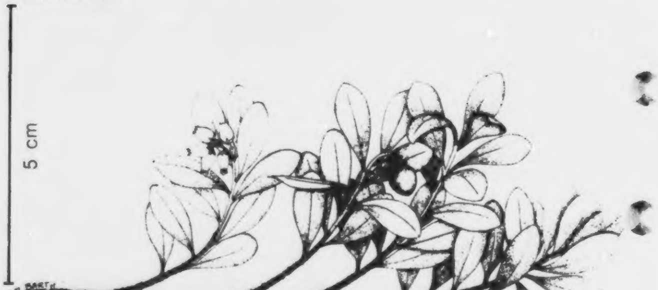


DWARF WOODY PLANTS

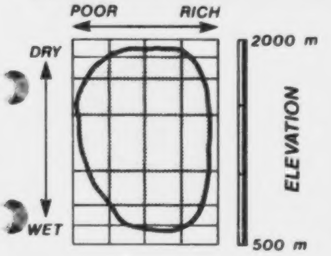
Arctostaphylos uva-ursi
(bearberry, kinnikinnick)

Rick Annas

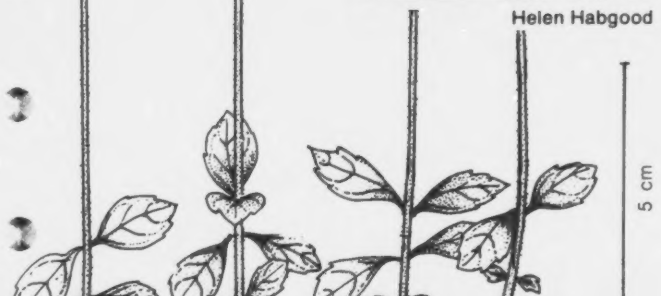




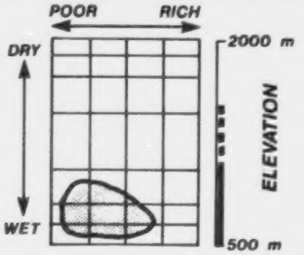
Linnaea borealis
(twin-flower)



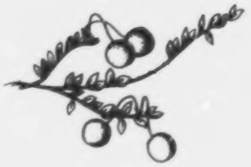
Helen Habgood

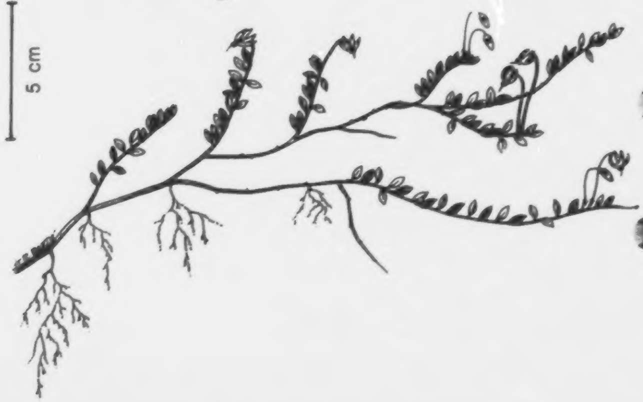

5 cm
G.R. BARTH

Oxycoccus microcarpus
(small bog cranberry)

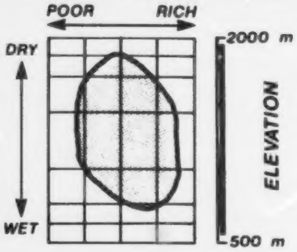


Julie Hrapko

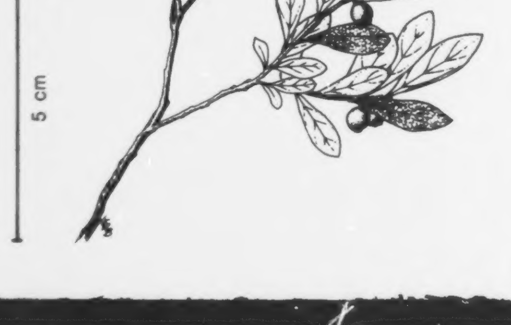




Vaccinium caespitosum
(dwarf bilberry)

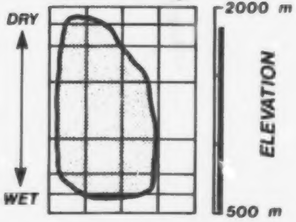


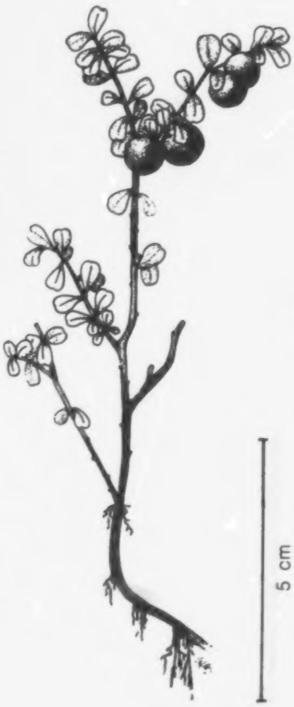
Helen Habgood



Vaccinium vitis-idaea
(bog cranberry, lingonberry)

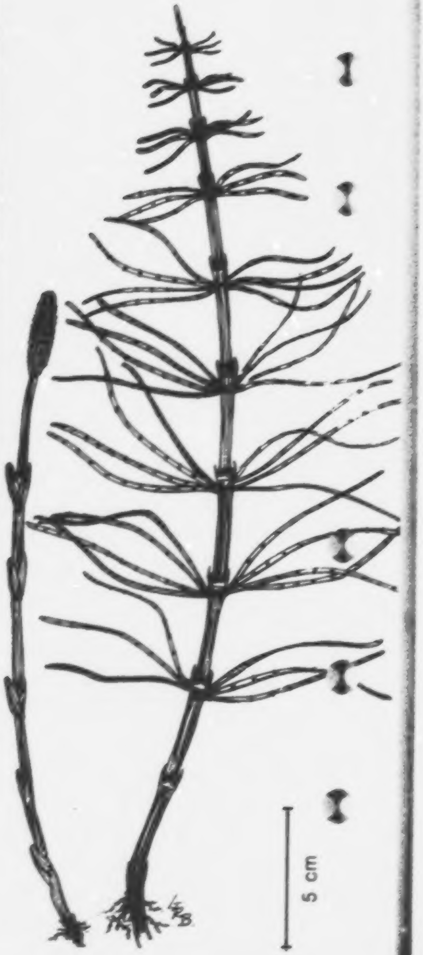
Derek Johnson

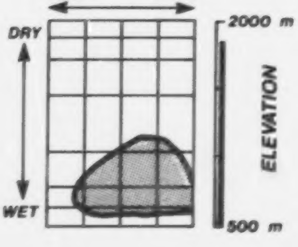




Equisetum arvense
(common horsetail)

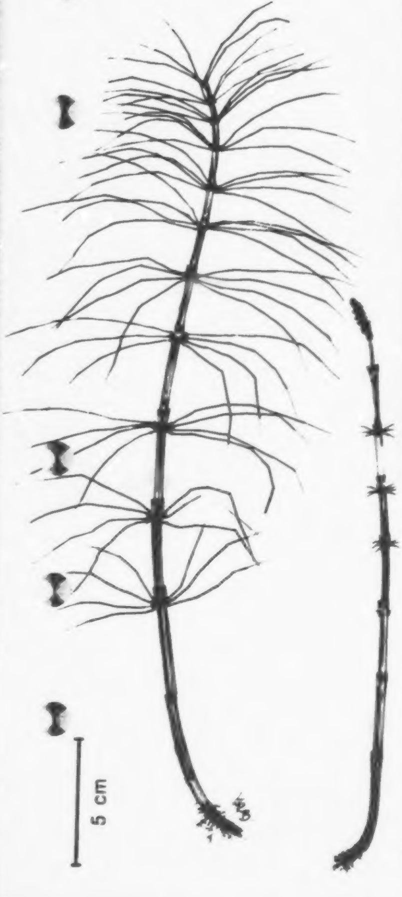
Helen Habgood

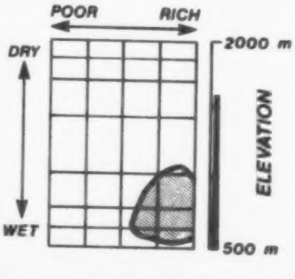




Equisetum pratense
(meadow horsetail)

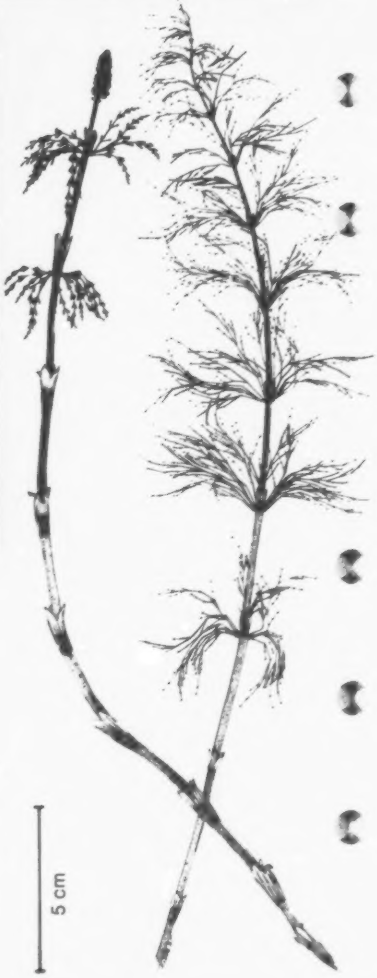
Helen Habgood

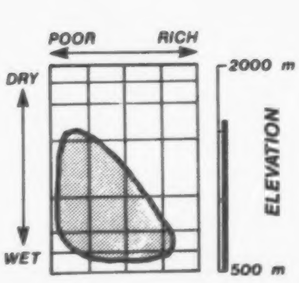




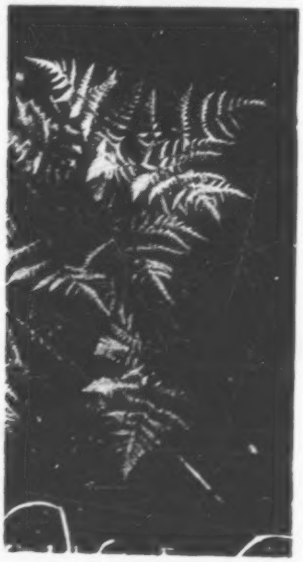
Equisetum sylvaticum
(woodland horsetail)

Helen Habgood

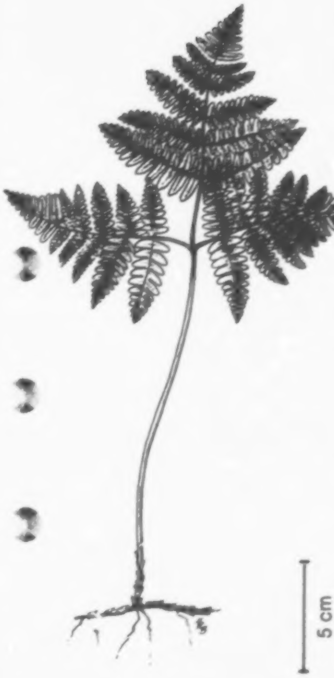


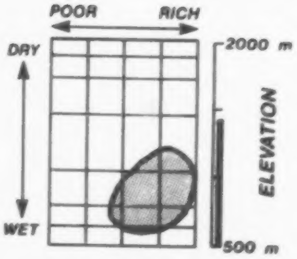


Gymnocarpium dryopteris
(oak fern)



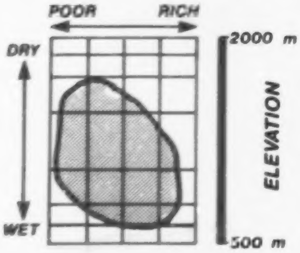
Julie Hrapko

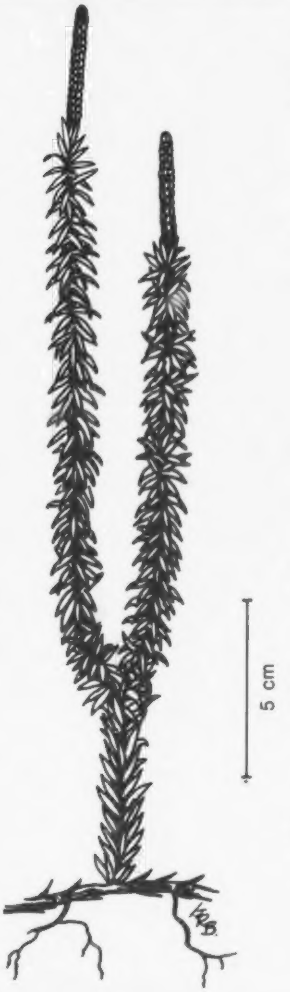




Lycopodium annotinum
(stiff club-moss)

Helen Habgood

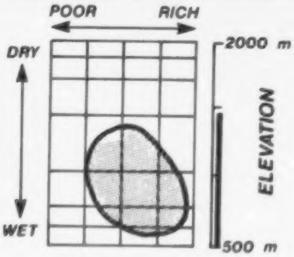


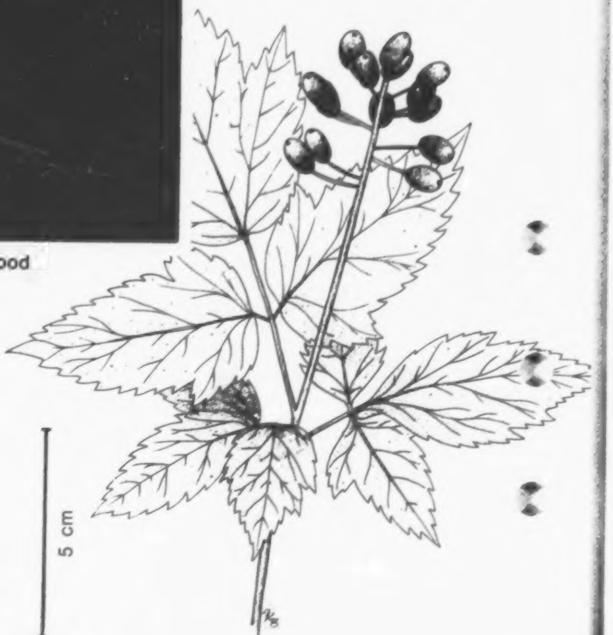


FORBS

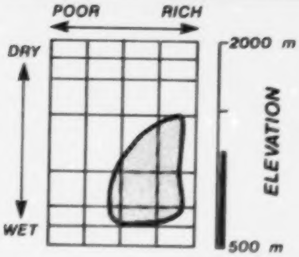
Actaea rubra
(baneberry)

Helen Habgood

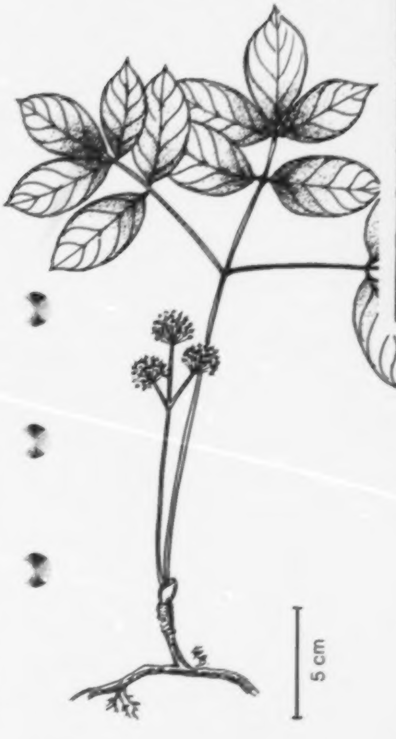




Aralia nudicaulis
(wild sarsaparilla)

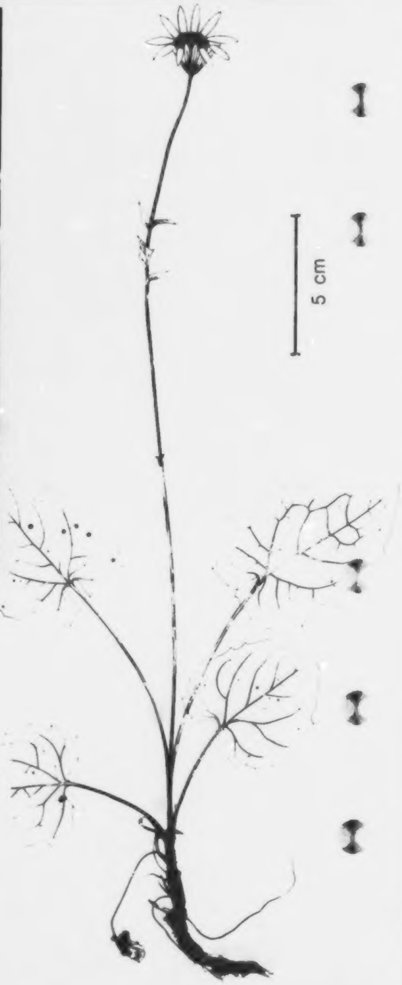


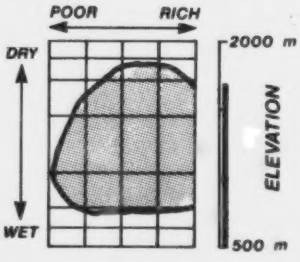
Derek Johnson



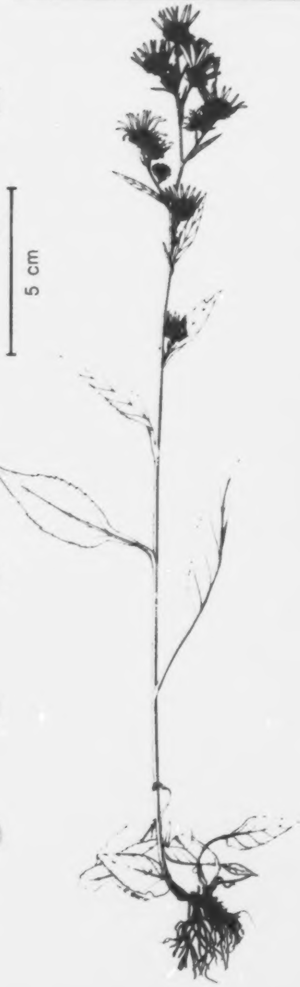
Arnica cordifolia
(heart-leaved arnica)

Helen Habgood

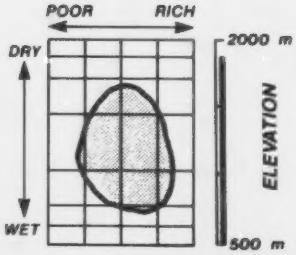




Aster ciliolatus
(Lindley's aster)

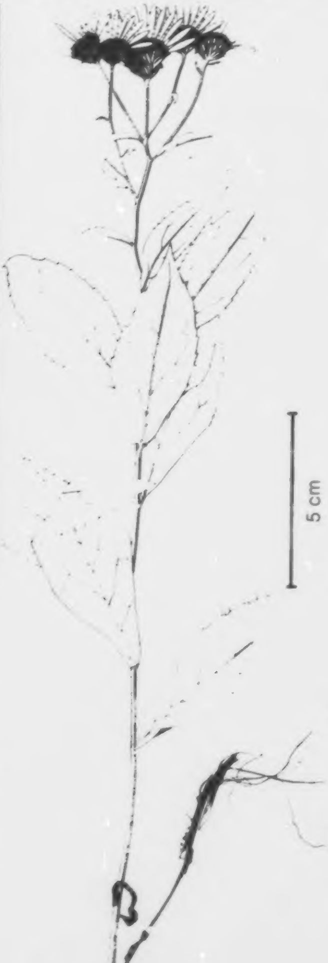


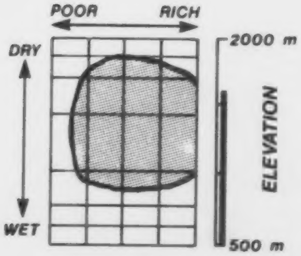
Helen Habgood


POOR
RICH
DRY
WET
2000 m
ELEVATION
500 m

Aster conspicuus
(showy aster)

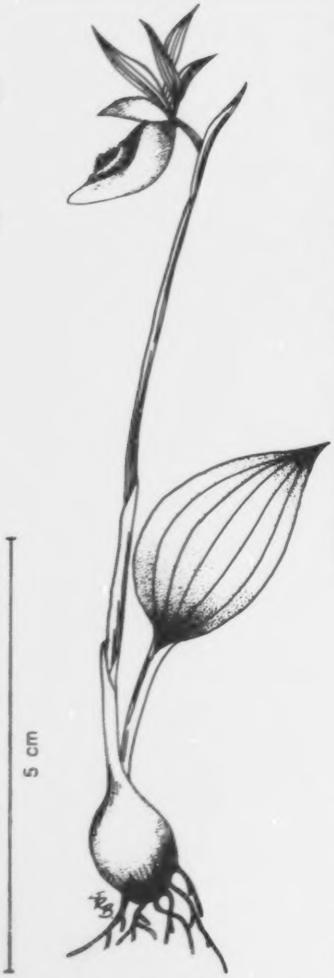
Helen Habgood



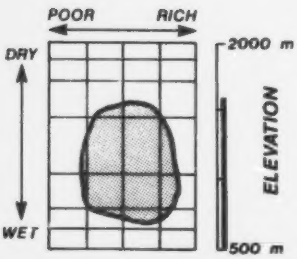


Calypso bulbosa

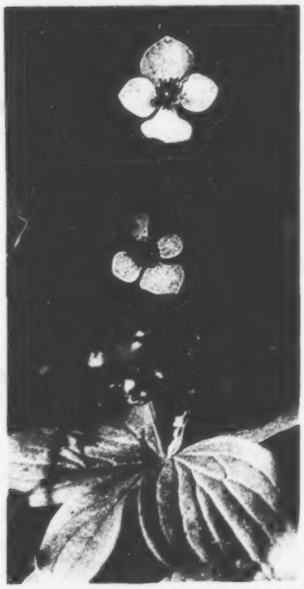
(fairy slipper, Venus'-slipper)



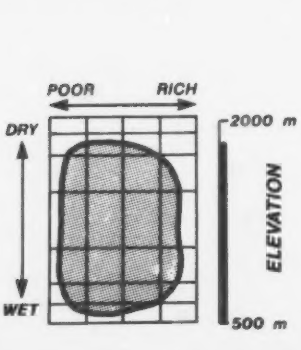
Rick Annas

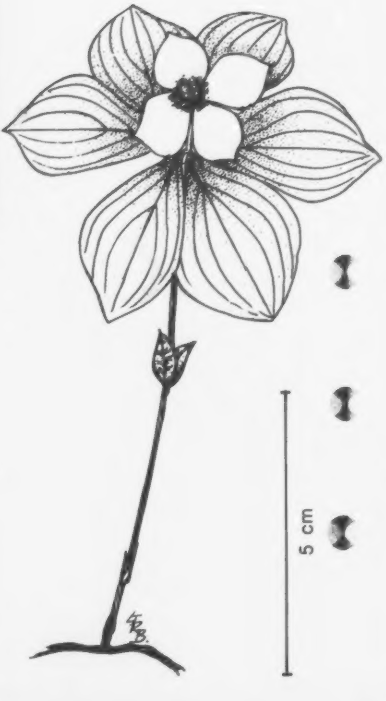


Cornus canadensis
(bunchberry)

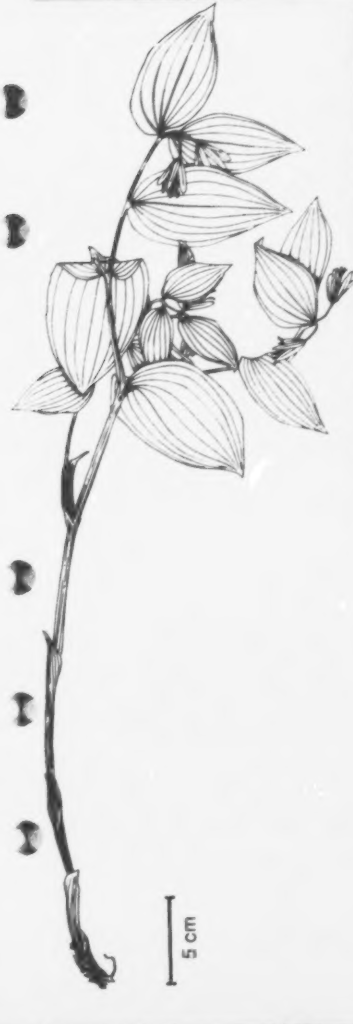


Helen Habgood (flowers)
Julie Hrapko (fruit)

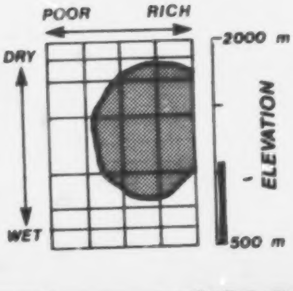




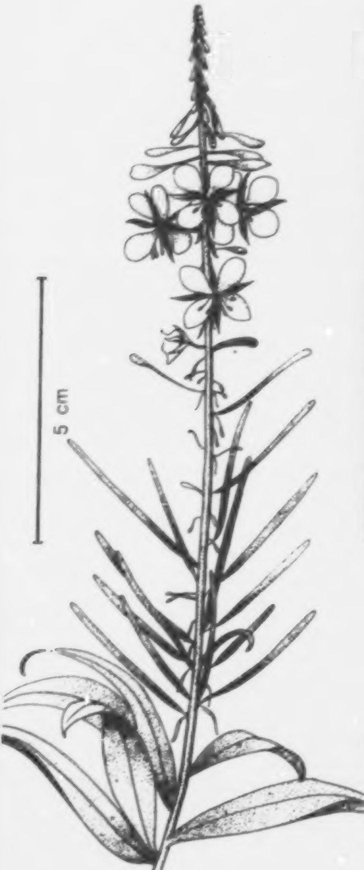
Disporum trachycarpum
(fairy bells)



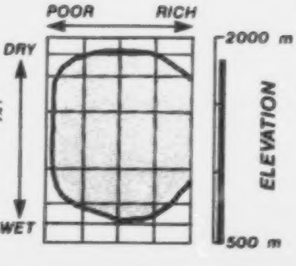
Julie Hrapko



Epilobium angustifolium
(fireweed)

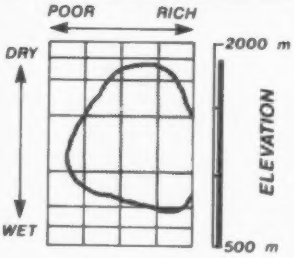


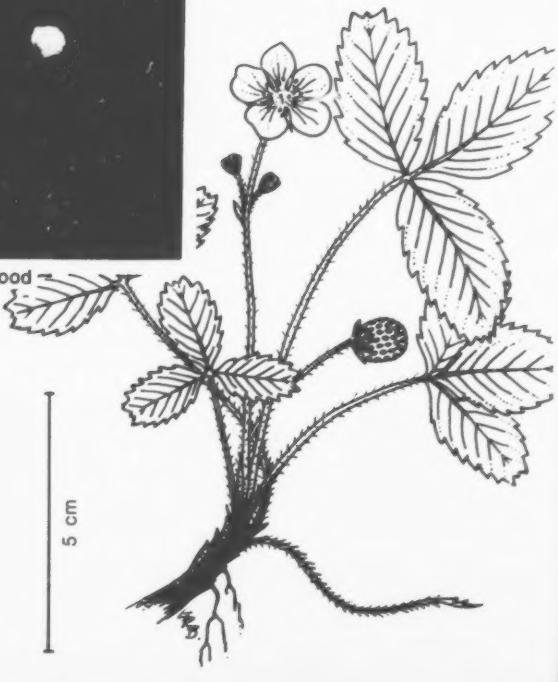
Helen Habgood



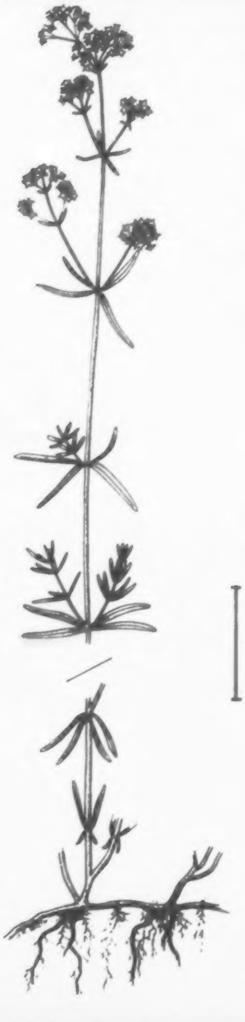
Fragaria virginiana
(wild strawberry)

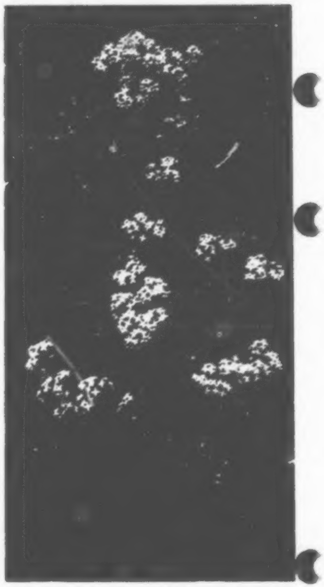
Helen Habgood



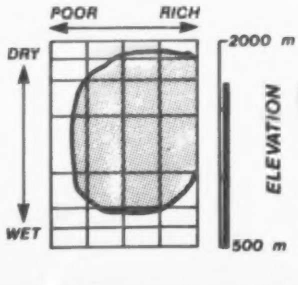


Galium boreale
(northern bedstraw)



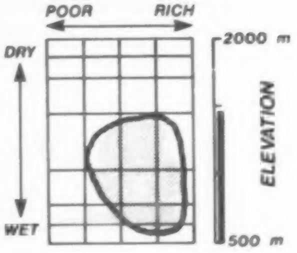


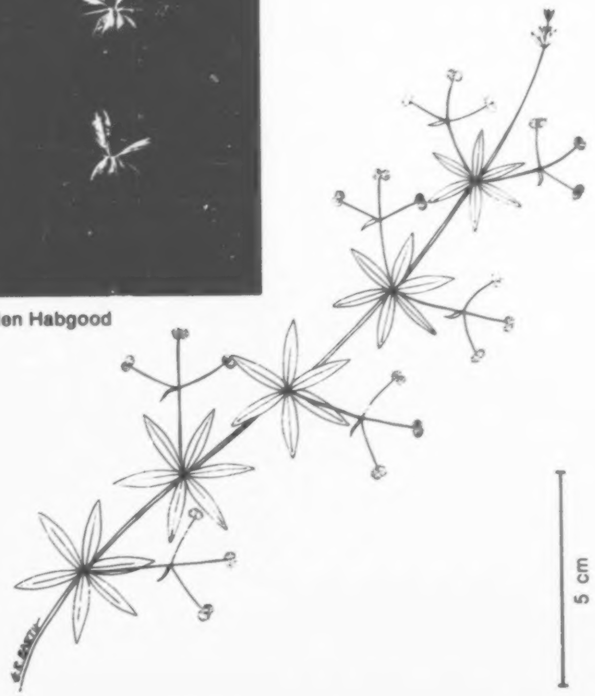
Robert Norten



Galium triflorum
(sweet-scented bedstraw)

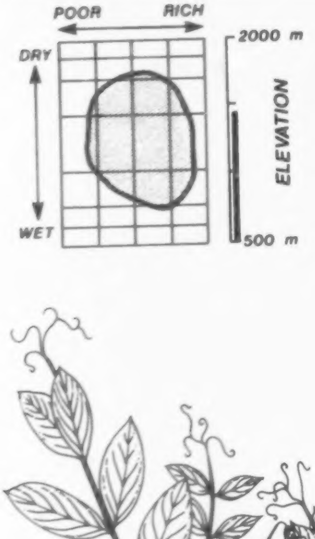
Helen Habgood



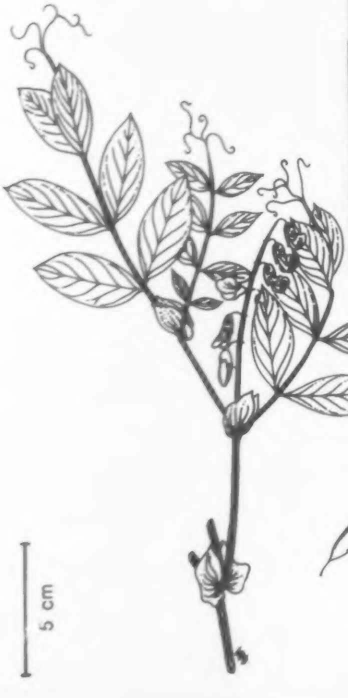


Lathyrus ochroleucus

(pea vine)



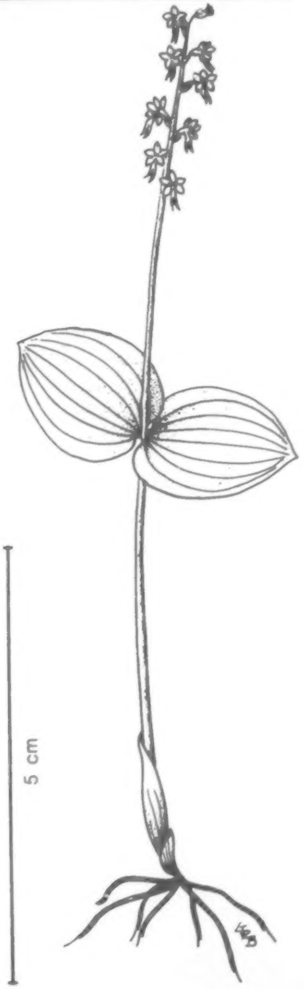
Julie Hrapko

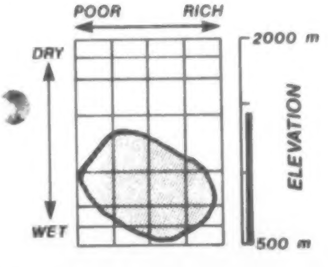


Listera cordata

(heart-leaved twayblade)

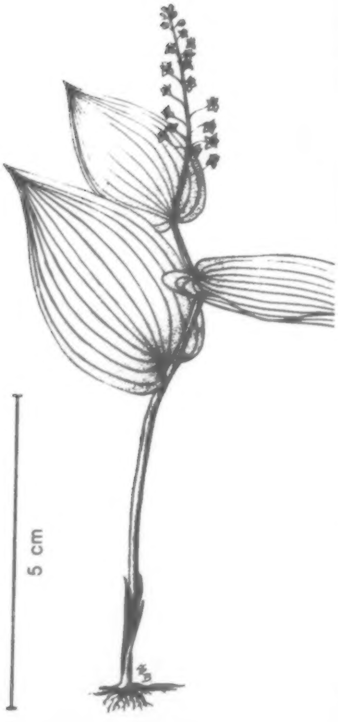
Helen Habgood

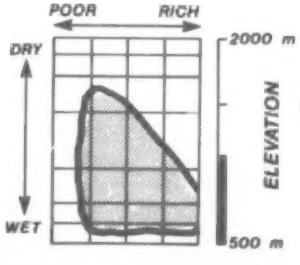




Maianthemum canadense
(wild lily-of-the-valley)

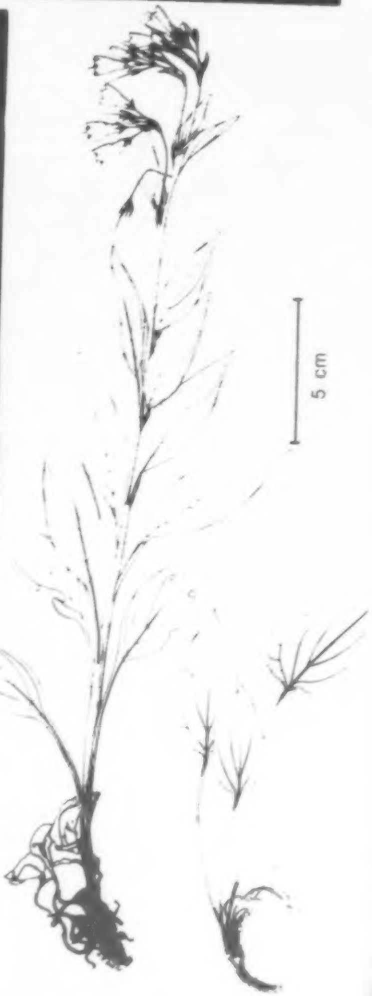
Helen Habgood

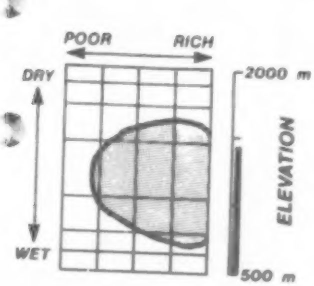




Mertensia paniculata
(tall mertensia)

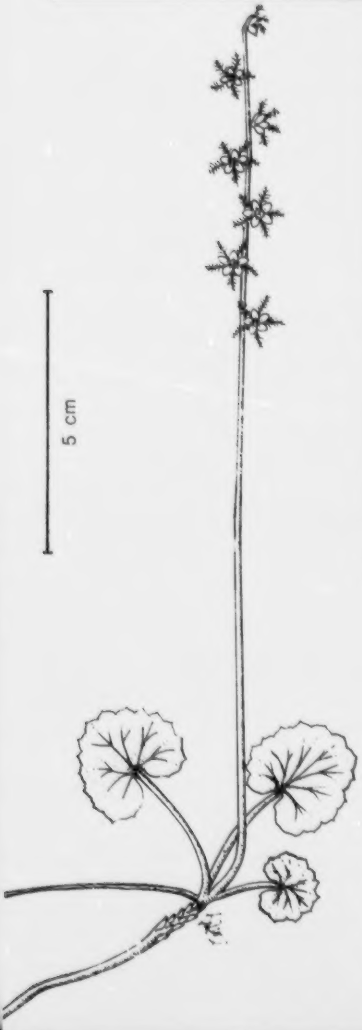
Julie Hrapko



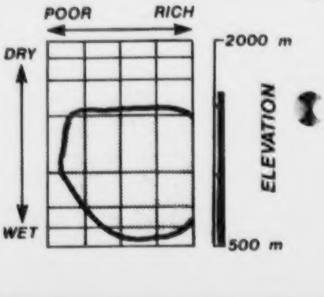


Mitella nuda

(bishop's-cap, mitrewort)

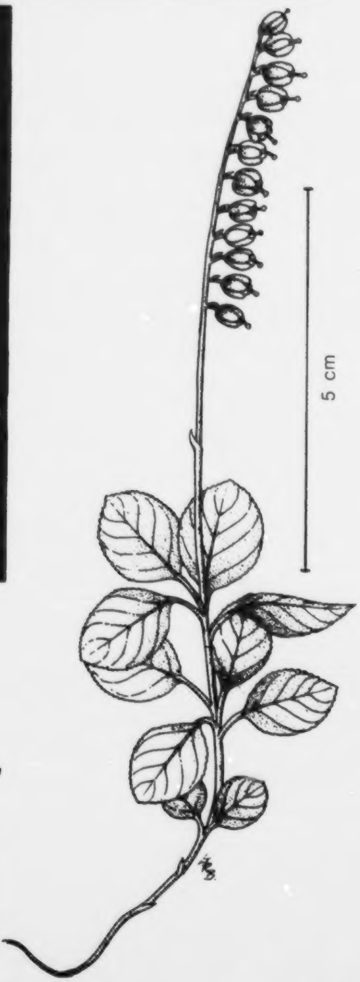


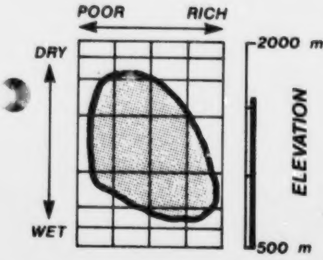
Julie Hrapko



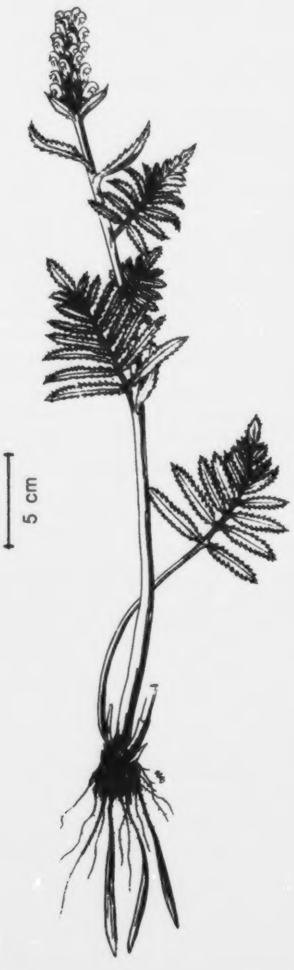
Orthilia secunda
(one-sided wintergreen)

Helen Habgood

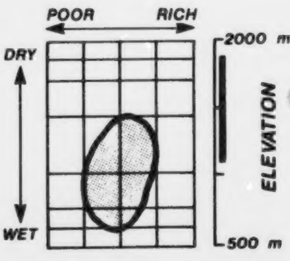




Pedicularis bracteosa
(bracted lousewort)

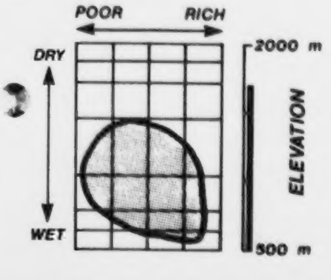


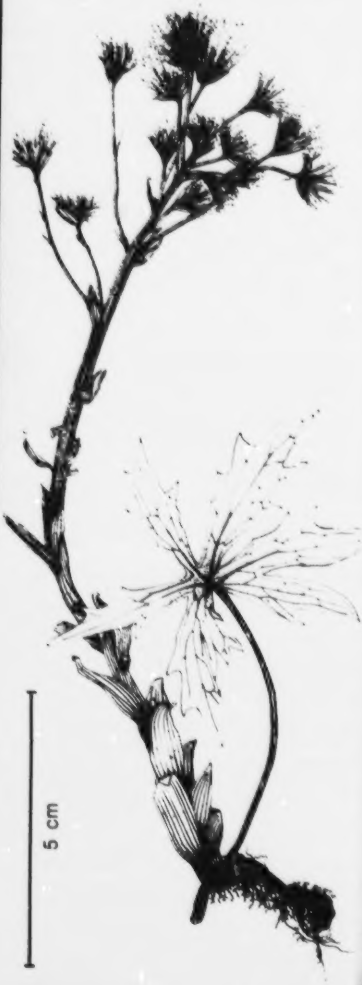
Julie Hrapko



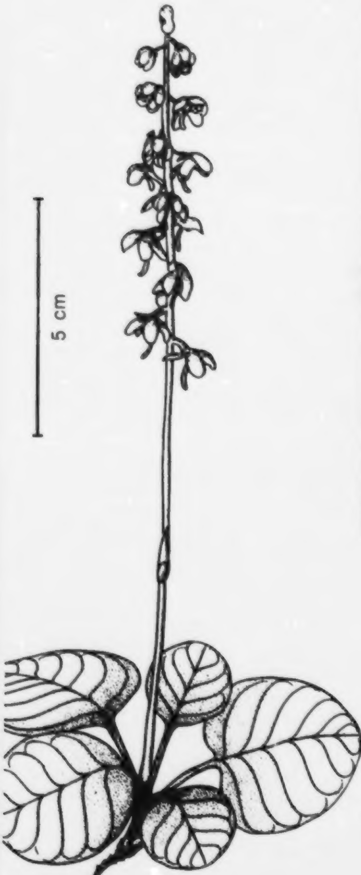
Petasites palmatus
(palmate-leaved coltsfoot)

Frank Boas

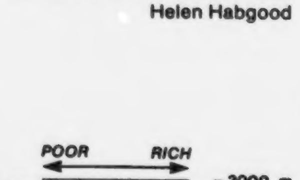




Pyrola asarifolia
(common pink wintergreen)

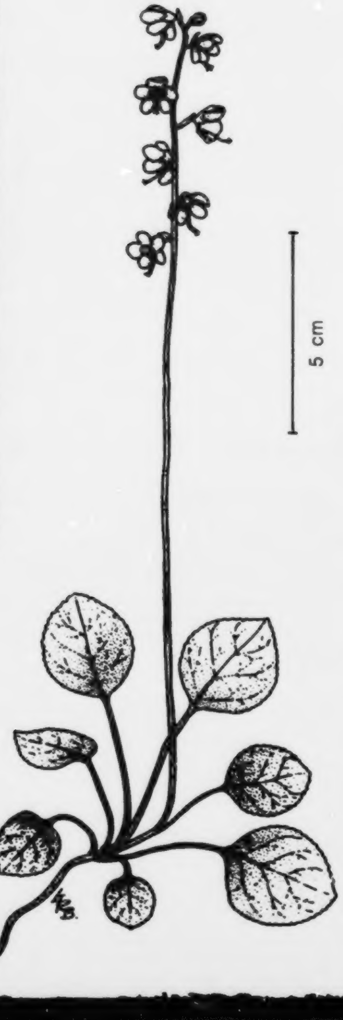


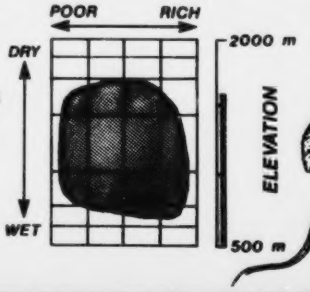
Helen Habgood



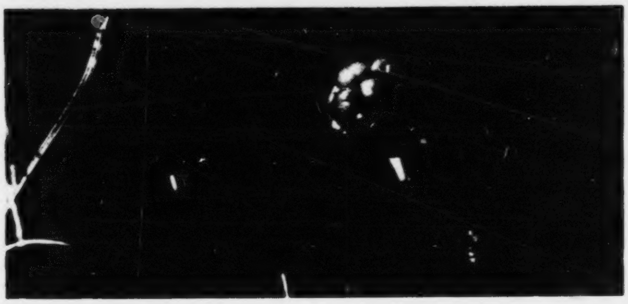
Pyrola chlorantha
(greenish-flowered wintergreen)

Helen Habgood

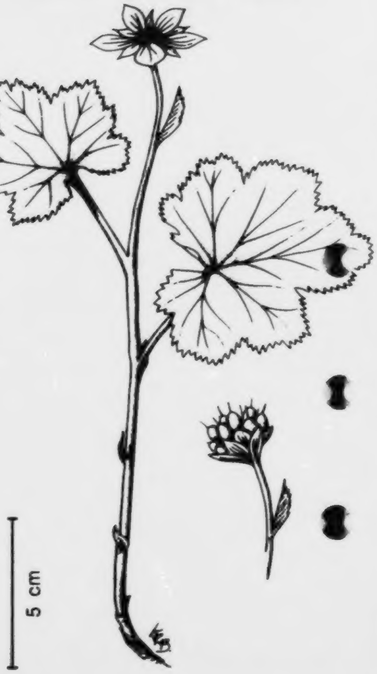


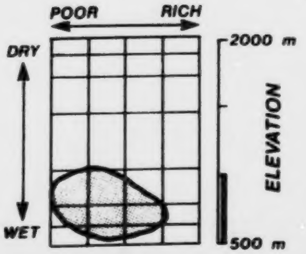


Rubus chamaemorus
(baked-apple berry, cloudberry)



Derek Johnson

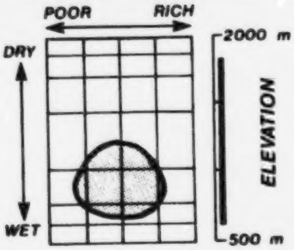


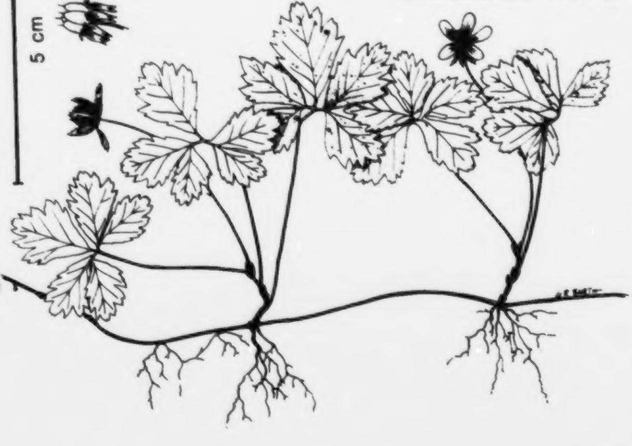


Rubus pedatus

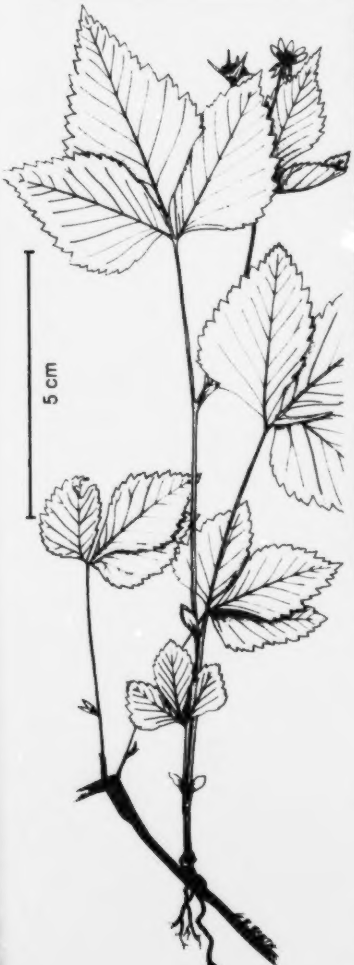
(five-leaved bramble)

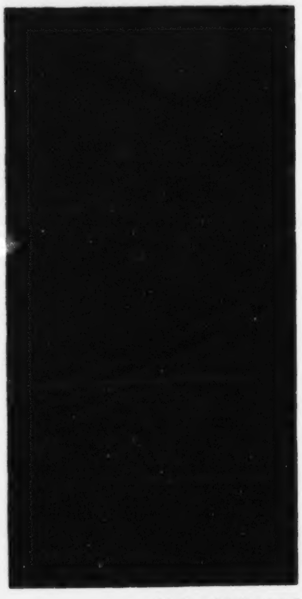
Helen Habgood



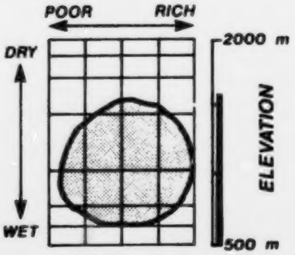


Rubus pubescens
(dewberry, running raspberry)

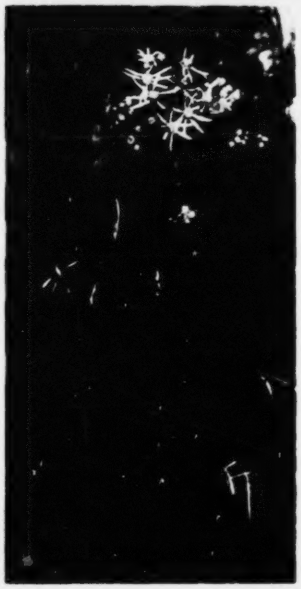




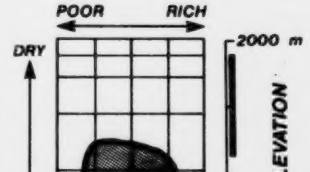
Helen Habgood

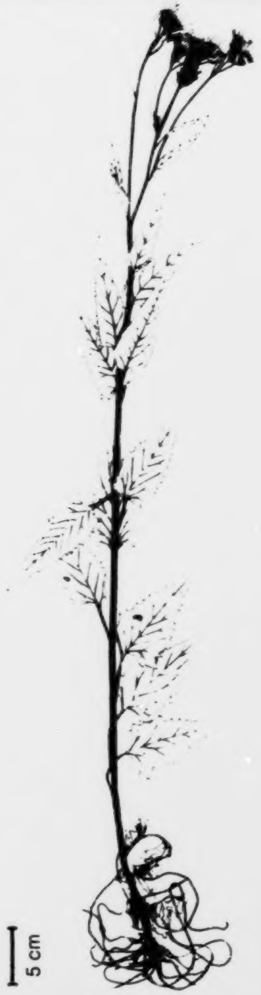


Senecio triangularis
(arrow-leaved groundsel, arrow-leaved ragwort)



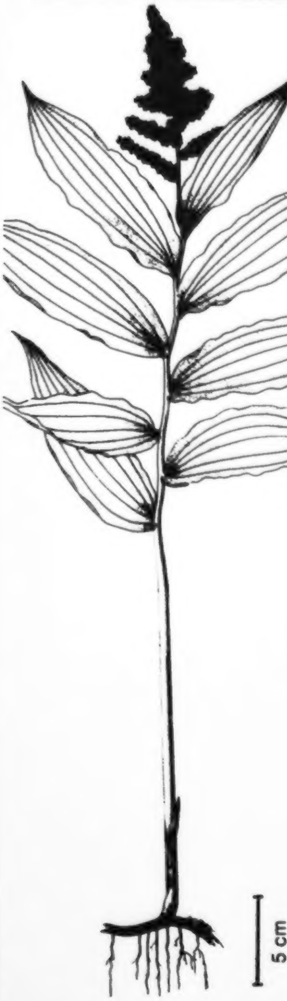
Helen Habgood

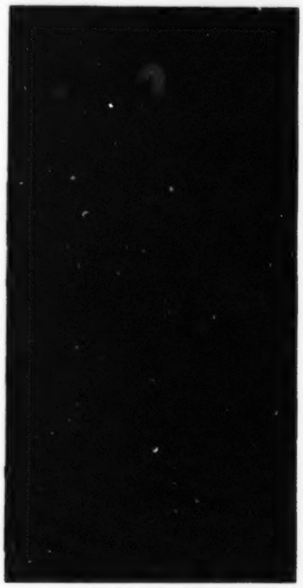




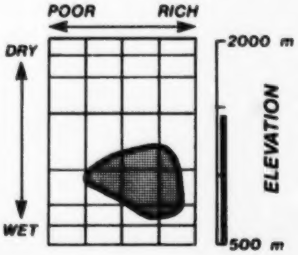
Smilacina racemosa

(false Solomon's-seal)

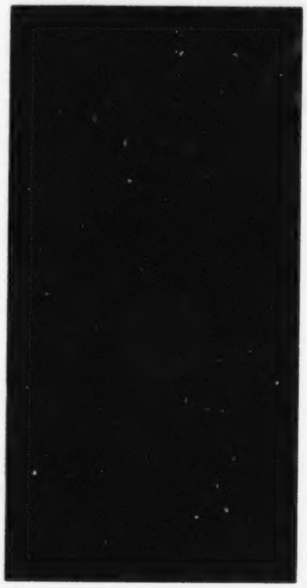




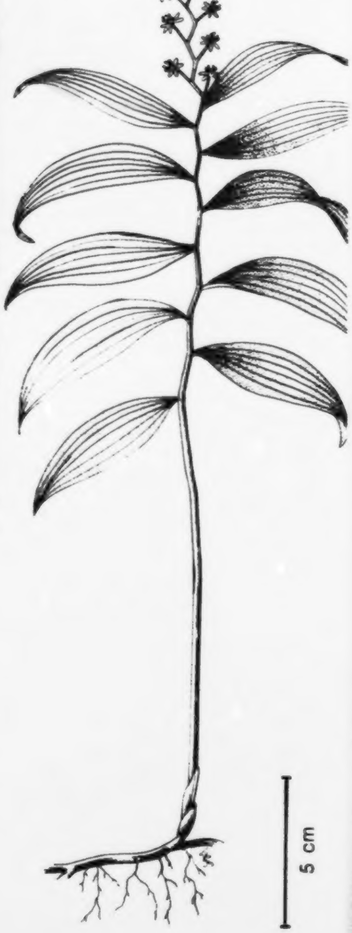
Derek Johnson

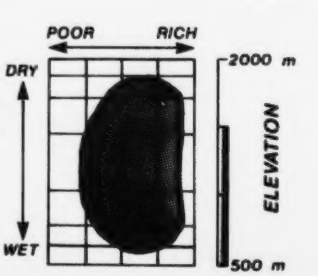


Smilacina stellata
(star-flowered Solomon's-seal)



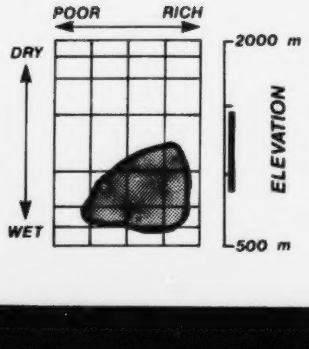
Julie Hrapko

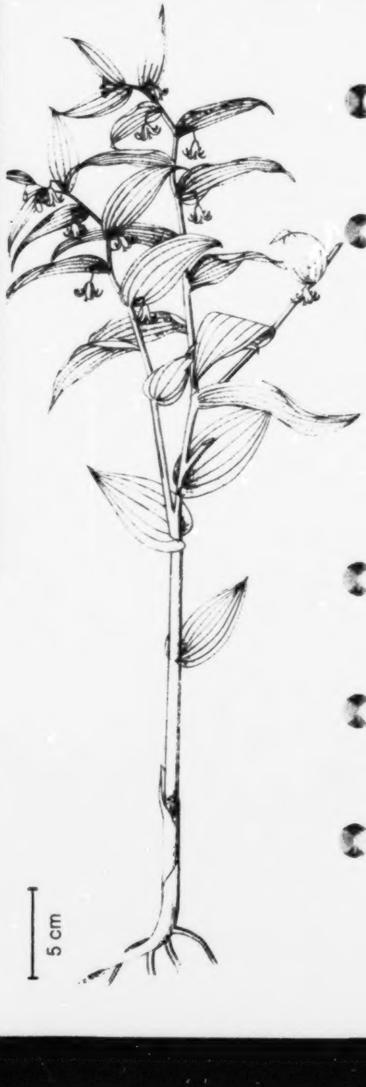




Streptopus amplexifolius
(twisted-stalk)

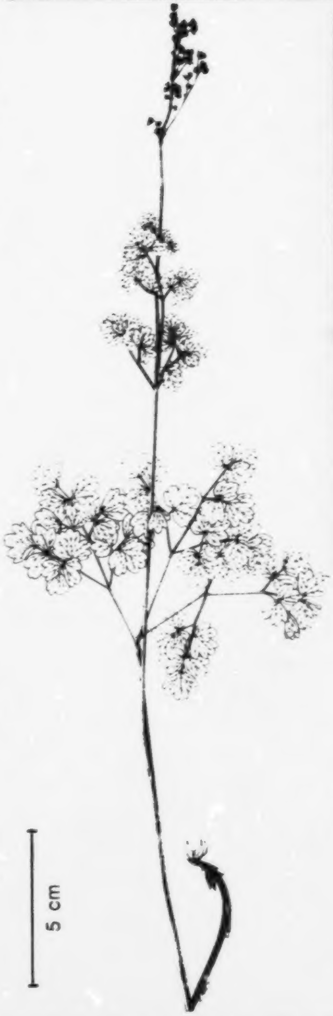
Helen Habgood



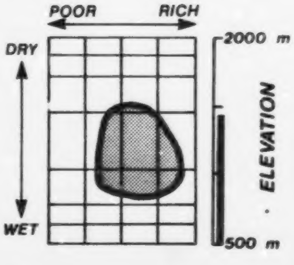


Thalictrum venulosum

(veiny meadow rue)



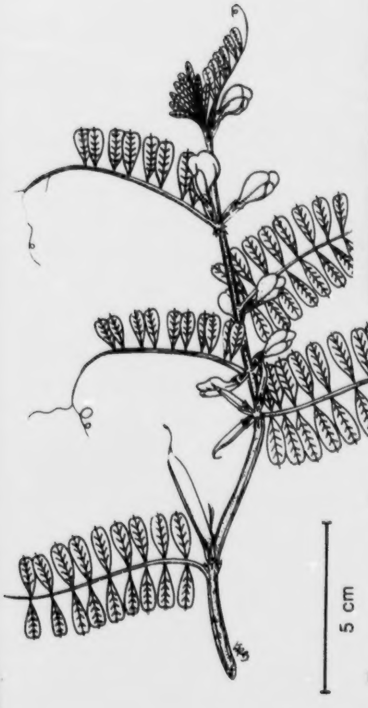
Helen Habgood

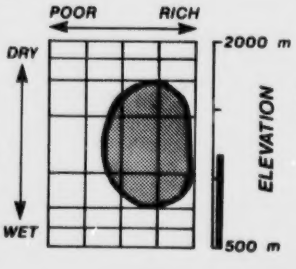


Vicia americana

(wild vetch)

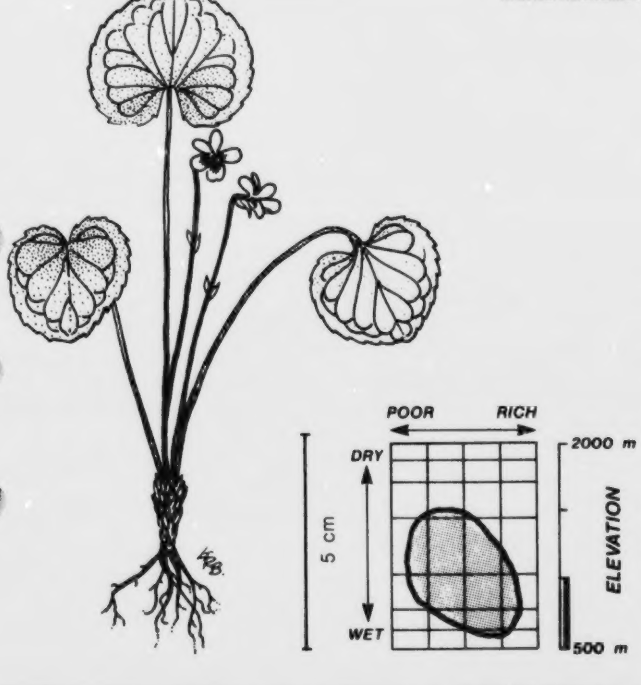
Helen Habgood





Viola renifolia
(kidney-leaved violet)

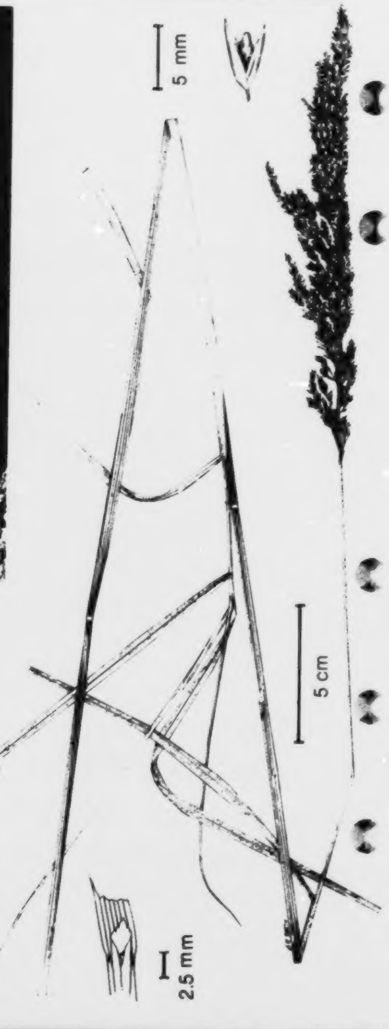
Derek Johnson

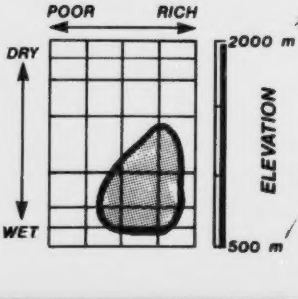

WB
5 cm
POOR
RICH
DRY
WET
2000 m
ELEVATION
500 m

Calamagrostis canadensis

(bluejoint, Canada reed grass, marsh reed grass)

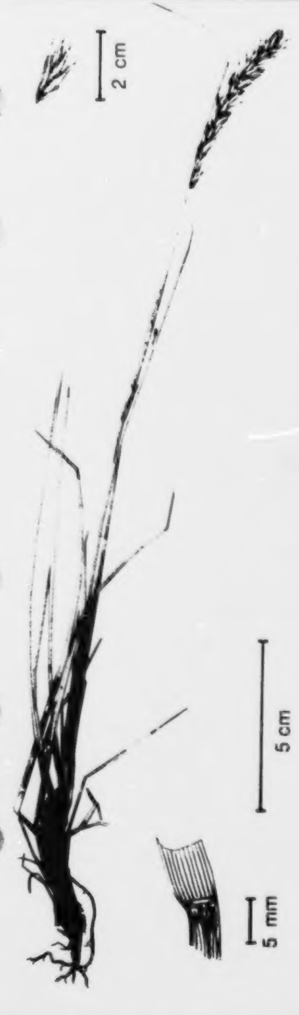
Bela Sivak


5 mm
5 cm
2.5 mm

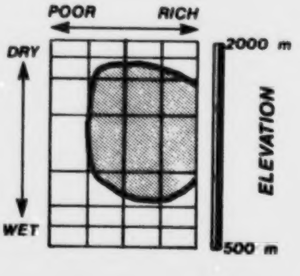


Elymus innovatus

(hairy wild rye)



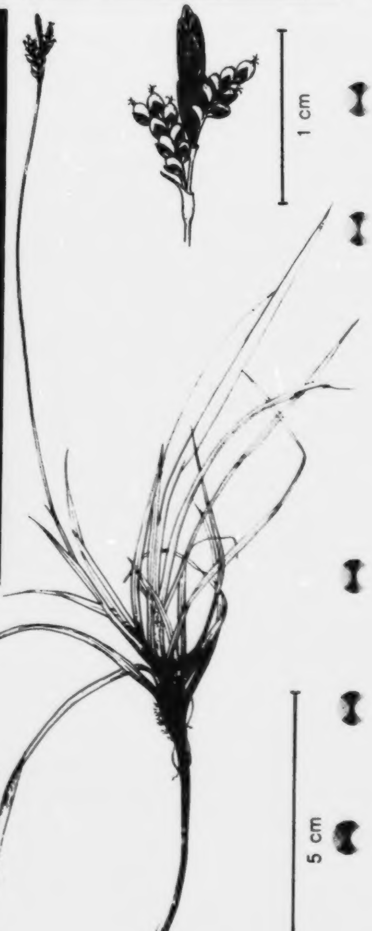
Helen Habgood

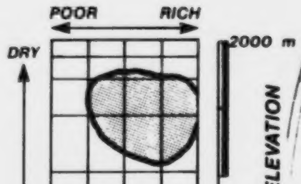


SEDGES

Carex concinna
(low northern sedge)

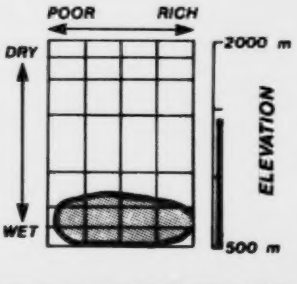
Helen Habgood





Carex vaginata
(sheathed sedge)

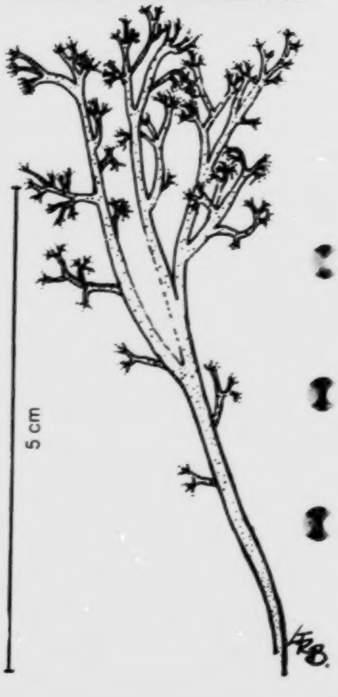
Helen Habgood

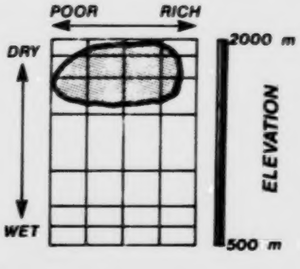


LICHENS

Cladina mitis
(reindeer lichen)

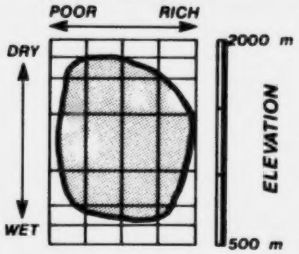
Ray Coupé

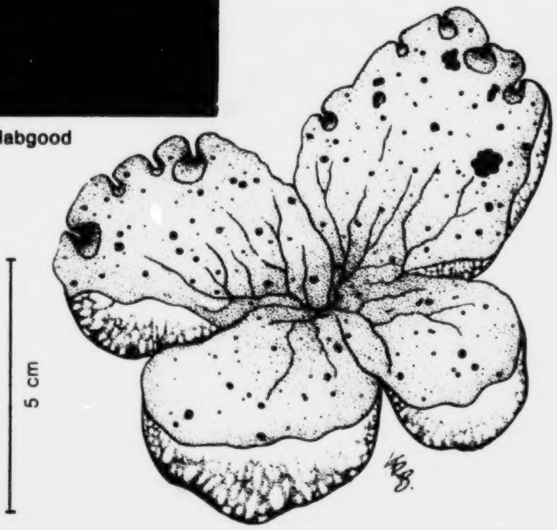




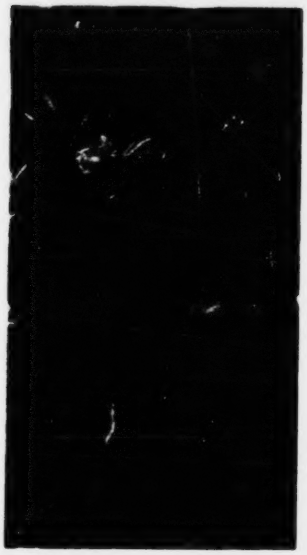
Peltigera aphthosa
(green dog lichen)

Helen Habgood

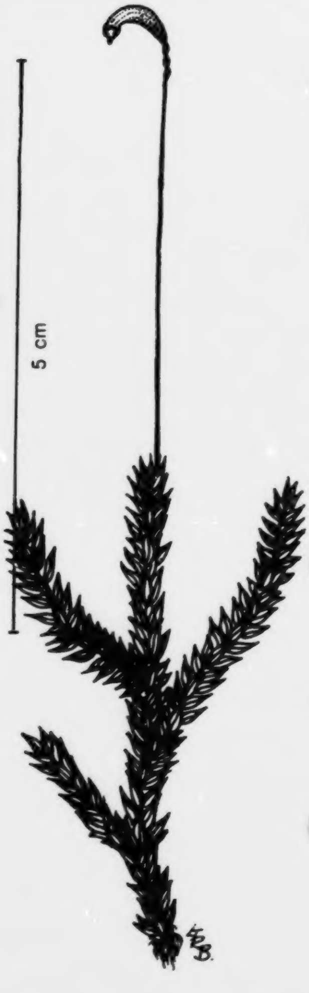


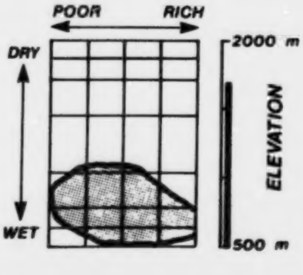


Aulacomnium palustre
(ribbed bog moss)

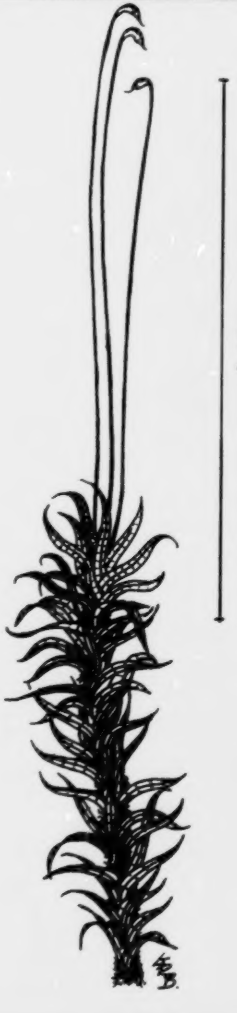


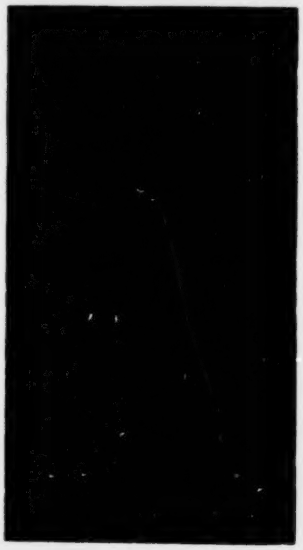
Frank Boas



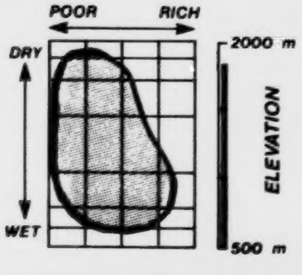


Dicranum polysetum



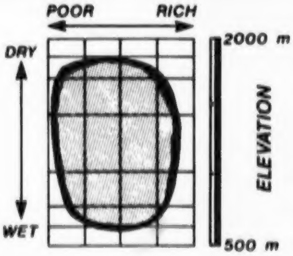


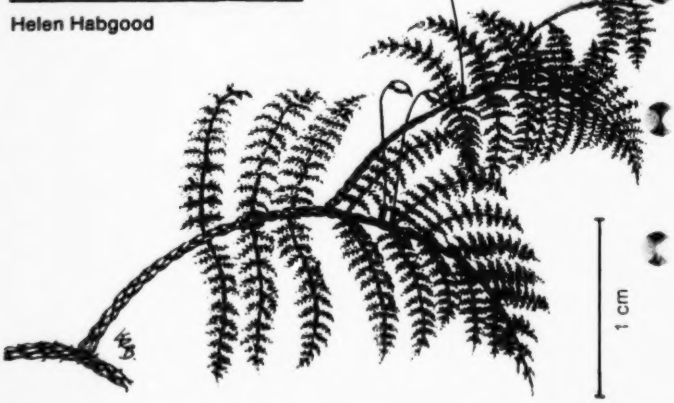
Frank Boas



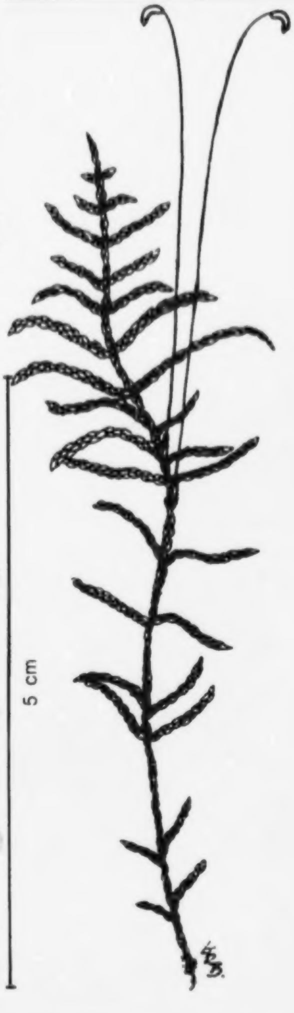
Hylocomium splendens
(feather moss, stairstep moss)

Helen Habgood

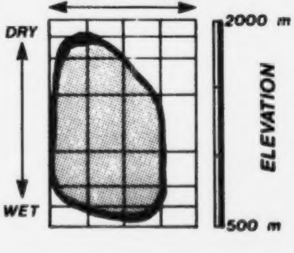




Pleurozium schreberi
(feather moss)



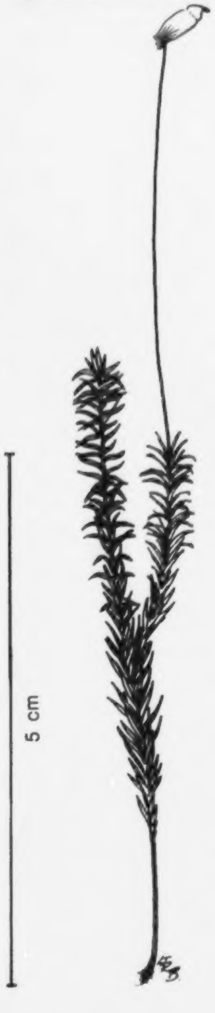
Helen Habgood

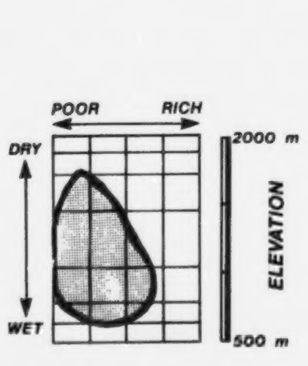


MOSSES

Polytrichum commune
(haircap moss)

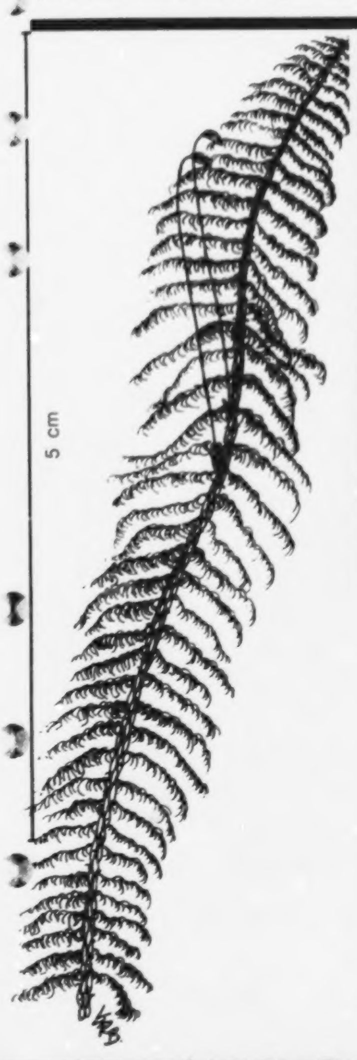
Frank Boas



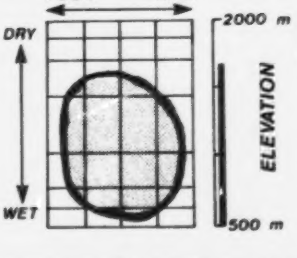


Ptilium crista-castrensis

(feather moss, knight's plume)



Helen Habgood

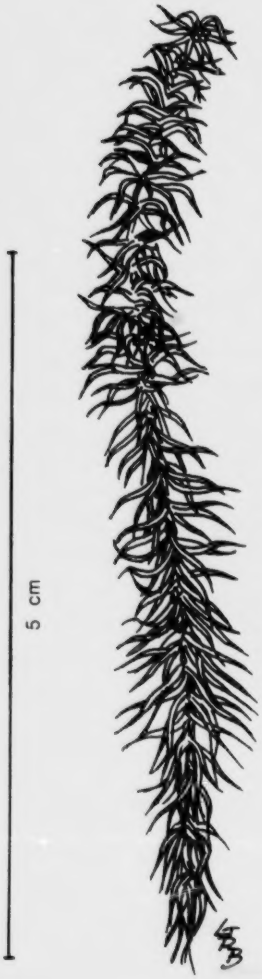

POOR
RICH
DRY
WET
2000 m
ELEVATION
500 m

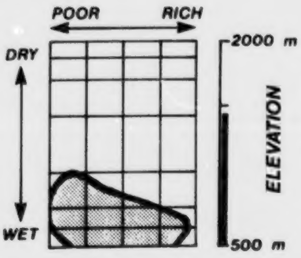
MOSSES

Sphagnum

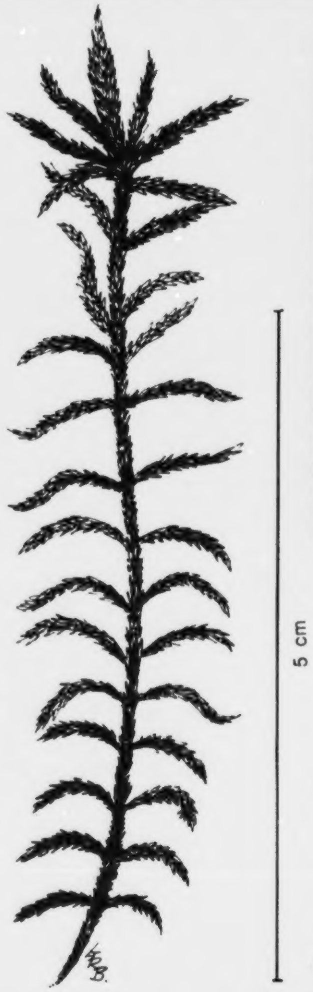
(peat moss)

Derek Johnson

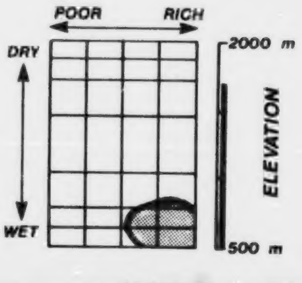




Tomenthypnum nitens
(brown moss)



Frank Boas



MANAGEMENT INTERPRETATIONS

Management interpretations were made for 15 forest management concerns based on the ecological classification and reconnaissance soil surveys for the study area. Although the management interpretations were briefly outlined earlier in the ecosystem association descriptions, the methodology and rationale governing their selection and rating are explained in this section. The management variables are discussed in the order in which they appear in the management interpretations grid. A summary of the forest management concerns and hazard ratings by soil unit/association appeared in Table 6 on pages 34-37.

Timber Harvest

Season

The recommended season of harvest (Table 7) is **winter (W)**, when the ground is frozen, or **all seasons (A)**. The choice depends largely upon the wetness of the site and its ability to support heavy equipment without site degradation. Sites suitable for summer harvest are generally also suitable for winter operations. All sites should be avoided during spring snow melt, when soil moisture is above field capacity.

Logging method

The logging method includes both the method of felling the timber and the means of removing the fallen logs from where they were felled.

Clear-cutting (CC) areas greater than 20 ha has generally proved to be a silviculturally satisfactory method of harvest on a wide variety of forest sites in Alberta, particularly those cut for lodgepole pine pulpwood and white spruce in northern boreal habitats. In old growth and uneven-aged spruce, **selective cutting (SC)** may be appropriate so that old trees are removed and younger trees are preserved and released. This also provides seed for natural regeneration, as long as openings are large enough so that low temperatures under the tree canopy are not a limiting factor. There are other methods and modifications (e.g., seed tree, shelterwood), but these do not appear well suited for most Alberta conditions, especially from an economic point of view.

The widely used rubber-tired skidders are satisfactory for most sites, although low-ground-pressure track skidders (e.g., FMC) or wide-tired skidders will minimize soil disturbance, compaction, and erosion on wet, fine-textured soils logged when the ground is not frozen. Heavy equipment such as feller-bunchers should be restricted to well-drained, coarse-textured soils to minimize compaction or should be used during winter when soils are frozen.

Site Preparation Intensity

Site preparation intensity recommendations (Table 8) are **low (L)**, **moderate (M)**, or **high (H)**. The

Table 7. Optimum season of harvest[1]

Internal drainage	Texture of B horizon[2]	Optimum season of harvest
Rapidly to moderately well	LS-S	All
Rapidly to moderately well	Textures finer than LS	Winter only[3]
Imperfectly to very poorly	All	Winter only

[1] The optimum seasons of harvest for the soil units/associations of the study area appear in Table 6.

[2] Texture symbols are as follows: L = loam(y) and S = sand(y)

[3] The main concern on well-drained, fine- to medium-textured soils is susceptibility to soil compaction rather than ability to support heavy equipment.

Table 8. Site preparation intensity[1]

Internal drainage	Vegetational competition	Slash abundance	Organic layer thickness (cm)[2]	Intensity[3]
Rapidly to moderately well	Low	L-M	<10	L
			10-15	M
			15-30	H
		H	>30	H
	Moderate	L-M	<15	M
		H	15-30	H
			>30	H
Imperfectly to very poorly	L-M	L-M	<15	M
			15-30	H
	High	L-H	<30	H
		L-H	>30	H

[1] Recommendations for site preparation intensity for the soil units/associations of the study area appear in Table 6.

[2] Where the organic layer is >30 cm, seedlings should be planted in moist, unvegetated organic matter on the side of the prepared trench.

[3] L = low, M = moderate, and H = high.

intensity of preparation required will depend upon the environment (including soil properties), vegetation competition hazard, seed supply, and the eventual reforestation method (page 221). Several options may accomplish similar results.

Low Intensity

These sites are generally moderately well to rapidly drained and have shallow (less than 10 cm) soil organic layers, minimal plant competition problems, and low to moderate slash abundance. Satisfactory lodgepole pine regeneration on many sites having a good cone supply may be achieved with minimal site preparation if the slash and cones are well distributed. Methods of low intensity site preparation include the following:

Screefing (mattock, boot, spade): These manual scarification methods may be appropriate when planting bare-root stock on topographically irregular sites, sites that are inaccessible to large machinery, sites where soil compaction may be a problem, small areas where it is expensive to move large machinery, and sites where plant competition (especially reedgrass (*Calamagrostis canadensis*)) is well established and when more-severe site preparation màу further stimulate competition.

Anchor-chain drags: This method gives satisfactory results on a wide variety of pine sites, and scarification intensity and degree of coverage can be regulated by the number and length of the drags. Caution should be taken to minimize soil compaction on sites with fine soil texture or weak structure.

Toothed scarifier blade: The main concern should be to redistribute slash (cones) if necessary, as the shallow organic layer should not pose a significant impediment to rooting seedlings. Soil compaction may be significant on fine-textured soils or on those with weak structure.

Moderate Intensity

These sites are moderately well to imperfectly drained, have moderately deep (10-15 cm) soil organic layers, moderate to high plant competition ratings, and low to moderate slash abundance. Methods of moderate intensity site preparation include the following:

Shark-fin barrels: This equipment does a satisfactory job on level to gently sloping moist sites with moderate slash abundance and moderately deep organic layers. Degree of scarification can be regulated by the amount of fluid put in the drums as well as the number and length of the attached anchor-chain drags.

Toothed scarifier blade: This equipment on a large tractor (e.g., Caterpillar D6 and larger) is capable of spreading large amounts of slash and penetrating deep organic layers.

Bracke scarifier: This machine can provide good results on mesic sites and sites where plant competition is a problem. It leaves planting sites with a wide range of moisture regimes from the top of the overturned soil and organic layer to the bottom of the scalp.

High intensity

These sites are poorly to imperfectly drained, with deep (15-30 cm) organic horizons, generally high plant competition rating, and low to high slash abundance. Methods of severe intensity site preparation include the following:

Marttiini plow: This rear-mounted plow is capable of exposing mineral soil on wet sites with deep organic layers. Compared with alternative equipment such as the C & S ripper plow, the Marttiini plow's large size and weight make it more difficult to maneuver and increase the chances of getting stuck, resulting in soil damage. Chances of subsoil glazing and compaction are greater with the Marttiini plow than with some other severe methods (e.g., ripper plow), although toothed edges on the plow will reduce glazing. Flooding of the furrow is a problem on very wet sites. Furrows should run perpendicular to slope contours to maximize soil drainage, but erosion can be a concern, particularly during spring runoff and on fine-textured till and lacustrine materials. The Marttiini is best suited to very gentle short slopes on less erodible materials (e.g., some tills).

Ripper plow (Craig-Simpson, C & S): This plow and adaptations of it have proved to be versatile machines for site preparation on wet sites, because it is more maneuverable than the larger Marttiini. The ripper plow is often used in conjunction with a brush rake or toothed scarifier blade to move heavy slash, particularly the currently unutilized hardwoods, into windrows.

Brush rake: This multitoothed bulldozer blade can effectively increase the receptive area for regeneration by putting heavy slash and unutilized hardwoods into windrows and by removing excess organic matter from the soil surface. As with other treatments that involve use of heavy equipment, soil compaction is likely to result.

Toothed scarifier blade: This blade can penetrate thick organic layers and spread heavy slash loads.

Cazes and Heppner plow (C & H): This wide, front-mounted V-blade can effectively remove virtually all vegetational competition (including well-established young trees) plus soil organic and surface mineral horizons. The resulting denuded surface can be very susceptible to erosion on slopes, especially where soils are fine-textured. Soil compaction and glazing of the subsoil could also be anticipated on fine-textured soils. The C & H plow is not advised for use on fine-textured soils or soils with excess water. The debris piled on both sides of the plow prevents lateral water movement at the soil surface and can cause flooding on the prepared seedbed. The edges of the bladed strips are usually the best sites for planting. In these situations, organic matter and nutrients are likely to be more abundant and susceptibility to drought and frost heave is likely to be less. Less-severe scarification methods are probably adequate preparation for planting on most sites, and the C & H plow should be restricted to areas of well-drained, medium- to coarse-textured, stable soils where stand conversion (e.g., aspen to lodgepole pine) is being attempted.

Soil Interpretations

Soil interpretations for the various ecosystem associations are based upon the predominant soils found with each type. Reconnaissance soils surveys completed over most of the study area (Dumanski et al. 1972, Knapik and Lindsay 1983, Twardy and Corns 1980) have rated soil mapping units for a variety of relevant interpretations, including soil water erosion hazard, windthrow hazard, and transplant mortality. Work done by others (Boyer 1979) has enabled ratings for soil compaction and puddling to be made for the predominant soils of each ecosystem type.

It must be recognized by the user that the ratings are general and relative and that variation outside the ratings in the ecosystem association descriptions can be expected, as the soils occurring with a given soil subgroup or map unit will have a range of properties. It is thus important to evaluate sites individually when site-specific information is desired. The ratings that were presented in Table 6 can be approximated by the operational forester by using the information and criteria provided here. The background information used to make the ratings comes from detailed sample plot data plus relevant soil survey reports (Dumanski et al. 1972, Knapik and Lindsay 1983, Twardy and Corns 1980, Twardy and Lindsay 1971). Only relative ratings can be provided, because quantitative data are scarce. Summarized interpretations for the soil units/associations of the study area appeared in Table 6.

Soil compaction

The degree of soil compaction is influenced by a number of soil physical properties, including texture, structure, percentage and type of coarse fragments, percentage organic matter, and organic layer thickness (Boyer 1979). Table 9 is adapted from Boyer (1979). Compaction reduces porosity and rate of water infiltration as well as increases physical impedence to growing roots (Pritchett 1979). The horizon that gives the most-severe rating in the upper 30 cm of mineral soil will determine the rating for the soil. Most of the soils of the study area, particularly those of the Lower Boreal Cordilleran and Boreal Mixedwood ecoregions, are expected to be more susceptible to compaction than those in the foothills within the Upper Boreal Cordilleran ecoregion due to predominantly fine-textured Continental tills in the east.

Table 9. Soil compaction hazard[1] (adapted from Boyer 1979)

Texture[2]	Coarse fragments	L & F (humus) thickness	Structure	Character of coarse fragments	Rating[3]
L, SiL, SiCL, CL, Si, HSL vfSL	<35%	<5 cm	Strong	All	M
			Mod. & weak	All	H
		>5 cm	Mod. & weak	All	H
			Strong	All	M
	35-60%	<5 cm	Mod. & weak	Rounded	M
				Angular	M
			Strong	All	L
		>5 cm	Mod. & weak	Angular	L
				Rounded	M
			Strong	All	L
	>60%	Any	All	All	L
LS, S	Any	Any	All	All	L
	>35%	Any	All	All	L
SiC, C, SC, SCL	<35%	<5 cm	Strong	All	L
			Mod. & weak	All	M
		>5 cm	Mod. & weak	All	M
			Strong	All	L

[1] Hazard ratings for the soil units/associations of the study area appear in Table 6.

[2] Texture symbols are as follows: L = loam(y), Si = silt(y), C = clay, S = sand(y), H = heavy, and vf = very fine.

[3] L = low, M = moderate, and H = high. In making a rating, consider the characteristics of the litter and upper 30 cm of mineral horizon(s). A wet or moist condition is assumed. The horizon that gives the poorest rating is used.

Increased soil compaction has been shown to reduce forest productivity in many parts of the world. Quantitative data are not yet available for our area. Soil compaction can be minimized by keeping heavy machinery off the more susceptible soils when they are wet, minimizing the area of logging roads on clear-cuts, and minimizing the number of passes over an area (Rothwell 1978). On susceptible soils, most compaction occurs during the first pass over the area by heavy equipment. Compaction effects can be longlasting[3], as has been found in the Pacific northwest (Froehlich 1973). Under some conditions the surface 10-20 cm of compacted soil will recover within a few years to a few decades. The deeper soil compaction appears to require substantially longer time periods, and the rate of this recovery is still largely unknown. Less is known of soil compaction effects for the Canadian boreal forest, where repeated freeze-thaw cycles may be expected to help ameliorate compaction damage. Winter logging and site preparation minimizes compaction, and the desirability of restricting summer operations to well-drained, coarse-textured soils is emphasized. Soil compaction effects are discussed further in reviews by Froehlich (1973) and Lull (1959).

Soil puddling

Puddling is the soil physical condition caused by the dispersal of soil particles that results in destruction of the soil structure and the formation of a dense crust on the soil surface. This crust has the same effect as a thin, compacted layer and is most common on soil surfaces where litter has been removed mechanically or by burning. Reduced germination and increased mortality may be expected on soils compacted or puddled by logging equipment (Pritchett 1979). Wet, fine-textured soils with few coarse fragments, shallow organic layers, and weak structure are most susceptible to puddling; soils of any texture with thicker organic layers, abundant coarse fragments, and strong structure are least susceptible (Boyer 1979). The ratings given in Table 10 make the assumption that the organic layer is less than 5 cm. If the organic layer is greater than 5 cm, a rating one class less severe (e.g., from moderate to low) would be applied.

Soil water erosion

Soil losses from forest areas are normally very small. Increased erosion and stream turbidity are due mainly to road construction and other activities that expose large areas of mineral soil (Pritchett 1979). Many factors influence the erodibility of soil and its parent materials: texture, type of structure, degree of carbonate cementing (parent materials), stone content, amount and type of vegetation cover, slope angle, length of slope, occurrence of recent fire, rainfall intensity and seasonal distribution, and rapidity of snow melt. Only water erosion is considered here. Wind erosion is generally not a problem in the study area, with the possible exception of some local soils in the Athabasca valley southwest of Hinton. Infiltration capacity and structural stability are regarded as most important in controlling water erosion (Buckman and Brady 1960).

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[3] Froehlich, H.A. 1982. The effects of mechanical operations on soil physical properties and forest productivity. Paper presented to the IUFRO symposium on site and continuous productivity, Seattle, Washington, Aug. 22-28, 1982. U.S. For. Serv., Pac. Northwest For. Range Exp. Stn., Portland, Oregon. Gen. Tech. Rep. PNW-163.

Table 10. Soil puddling hazard[1] (adapted from Boyer 1979)

Texture[2]	Coarse fragments	L & F (humus) thickness	Structure	Rating[3]
C, SiC, Si, SiL, SiCL, SC, CL, vfSL	<35%	≤5 cm	Strong	M
			Mod. & weak	H
		>5 cm	Mod. & weak	H
			Strong	M
	35-60%	≤5 cm	Mod. & weak	M
			Strong	L
		>5 cm	Strong	L
			Mod. & weak	M
	>60%	Any	All	L
LS, S	Any	Any	All	L
L, SCL, SL	>35%	Any	All	L
	<35%	≤5 cm	Strong	L
			Mod. & weak	M
		>5 cm	Mod. & weak	M
			Strong	L

[1] Hazard ratings for the soil units/associations of the study area appear in Table 6.

[2] Texture symbols are as follows: C = clay, Si = silt(y), L = loam(y), S = sand(y), and vf = very fine.

[3] L = low, M = moderate, and H = high. In making a rating, consider the characteristics of the litter and upper 30 cm of mineral horizon(s). A wet soil condition is assumed. The horizon that gives the poorest rating is used.

Soil erosion hazard is the expected rapidity and amount of soil loss due to wind and/or water that may be expected following removal of the protective vegetation cover in areas where the proper erosion control measures are not implemented (Dumanski et al. 1972). Because of the many factors determining erodibility, generalized relative erodibility hazard ratings for soils under a plant association must be made assuming average rainfall intensity and rate of spring snow melt, using information published in reports by Dumanski et al. (1972), Knapik and Lindsay (1983), Rutter (1968), and Twardy and Corns (1980). Erosion will increase as slope steepens up to 80% (40°), thereafter decreasing to nothing as steepness approaches 200% (90°) (Rutter 1968). Erosion will be greater on long slopes.

The relative water erosion hazard ratings described in Table 11 are based primarily on soil texture, estimates of infiltration and permeability rates, soil structure, soil wetness, and slope angle, where surface organic layers have been removed.

Low: Parent materials (and soils developed on them) with a usually low erosion hazard include medium- to coarse-textured tills (slopes <10%), colluvial materials (slopes <5%), glaciofluvial gravels, unconsolidated bedrock (sandstones and shales; slopes <5%), and organic soils (slope <5%).

Moderate: Parent materials (and soils developed on them) with usually moderate erosion hazard include fine- to moderately fine-textured tills (slopes <10%), medium- to coarse-textured tills (slopes 10-15% or up to 60% if very stony), colluvial materials (slopes 5-30%), eolian deposits, and unconsolidated bedrock (sandstones and shales; slopes 5-9%).

High: Parent materials (and soils developed on them) with a usually high erosion hazard include glaciolacustrine deposits (any slope), glaciofluvial and fluvial sands and silts (any slope, especially Gleysolic soils), fine- to moderately fine-textured tills (slopes >10%), medium- to coarse-textured tills (slopes <5% or steeper, depending on stoniness), colluvial materials (slopes >30%), and unconsolidated bedrock (slopes >9%).

Ratings of individual soil units mapped in the study area are available in reconnaissance soil surveys by Dumanski et al. (1972), Knapik and Lindsay (1983), and Twardy and Corns (1980).

Methods for minimizing erosion as a result of logging and road construction in Alberta are discussed by Lengellé (1976) and Rothwell (1978). A variety of practical bioengineering methods using vegetation as a means of stabilizing slopes and reducing erosion are discussed by Schiechtl (1980).

Reforestation Interpretations

Species selection

The species selected to reforest a site will depend upon both its biological and economic suitability. The latter is more difficult to judge, since it is virtually impossible to know what forest products will be available to and desired by the consumer at the end of the rotation.

Clues to tree species that are biologically well-adapted to a site can be determined from soil physical and chemical properties and the species (tree and understory) that naturally occupy the site. Climate, soil moisture regime, and to some extent nutrient regime can be inferred from the composition of the vegetation. Soil properties, particularly drainage and pH, will have a strong bearing upon the species selected for planting on a site.

Table 11. Soil water erosion hazard[1]

Parent material	Texture B horizon[2]	Slope (%)	Hazard[3]
Till	Medium to coarse	<10	L
Colluvium, glaciofluvial gravels, unconsolidated bedrock (sandstone, shale), organic	Variable	<5	L
Till	Fine to moderately fine	<10	M
Till	Medium to coarse	10-15	M
Till	Very stony variable texture	16-60	M
Colluvium	Variable	5-30	M
Eolian	Coarse	0+	M
Unconsolidated bedrock	Variable	5-9	M
Glaciolacustrine	Fine	0+	H
Glaciofluvial, fluvial	Medium to coarse	0+ (especially Gleysols)	H
Till	Fine to moderately fine	>10	H
Till	Medium to coarse	>15	H
Colluvium	Variable	>10	H

[1] Hazard ratings for the soil units/associations of the study area appear in Table 6.

[2] Textural groups are as follows: fine—sandy clay, silty clay, heavy clay; moderately fine—clay loam, sandy clay loam, silty clay loam; medium—very fine sandy loam, loam, silty loam, silt; moderately coarse—sandy loams; coarse—sands, loamy sand.

[3] L = low, M = moderate, H = high. Ratings assume unvegetated surface. Dense vegetation cover will reduce hazard by at least one class.

The current Alberta Forest Service Planning and Harvesting Ground Rules for Forest Management Area holders specify that tree regeneration on cutover areas must average 1.8 to 2.5 m in height before adjacent trees can be removed in the second cut. This guideline plus economy appear to encourage reforestation using initially faster growing pine on sites that might be better suited to spruce production when the whole rotation period is considered. It is unknown if the rapid initial growth advantages of establishing pine rather than spruce will result in the best economic yield or wildlife habitat in the long term.

The interpretations made for tree species suitability consider only species native to the study area and are based primarily upon the inferred ecological suitability of the site. Current markets for particular forest products have no bearing upon the interpretations. In addition to climate and knowledge of tree growth on various sites, the principal factors considered are soil drainage, soil reaction (pH), organic layer properties (principally thickness), and soil texture (Table 12). These factors were integrated in the classification of the ecosystem associations, and species selection interpretations have been made for each ecosystem association. Most of the soil information can be determined for the area in question from the reconnaissance soil survey reports and accompanying maps (Dumanski et al. 1972, Knapik and Lindsay 1983, and Twardy and Corns 1980). All factors should be considered together when rating a site in order to select the best species. On sites that are environmentally suitable for more than one species, anticipated future markets may determine the selection.

Reforestation method

Reforestation method here refers to the means by which satisfactory tree stocking is achieved on logged areas. The alternatives are **natural** seeding from slash or adjacent trees, **root suckers** (aspen), manual or **direct seeding (DS)**, **container (C)** planting stock, and **bare-root (BR)** planting stock (Table 13). The situations applicable to the various options are discussed below:

Natural:

i) *Pine*—Sites with good cone crops, soils moderately to well or better drained, and organic layers less than 10 cm thick can generally be adequately restocked without additional planting. A light scarification is usually necessary to bring cones into contact with mineral soil.

ii) *Spruce*—Satisfactory natural spruce stocking is likely to be attained only on sites with a continuing seed source, such as on small patch or strip cuts or where seed trees are left, and will be favored where mineral soil is exposed and moisture is neither limited nor in excess.

iii) *Aspen*—Satisfactory natural aspen stocking is usually

Table 12. Species selection[1] for reforestation

Species	Elevation (m)	Drainage	pH	Organic thickness (cm)	Soil texture
Aspen	<1100	Well to moderately well	5-7	<10	Heavy clay-loam
White spruce	600-1300	Well to imperfectly	4.5-7.5	<20	Heavy clay-loam
Black spruce	600-1650	Well to poorly	3-6.5	10-30+	Organic, heavy clay-sandy loam
Engelmann spruce[2]	1300-1650	Well to imperfectly	4.5-7.5	<20	Clay loam-sandy loam
Lodgepole pine	600-1650	Rapidly to imperfectly	3-6	<10	Clay loam-sand
Balsam fir (low elevation)	600-1300	Well to imperfectly	4.5-6.5	10-20	Heavy clay-sandy loam
Balsam fir[3] (high elevation)	1300-1650	Well to imperfectly	4.5-6.5	10-20	Heavy clay-sandy loam

[1] Species suitability for the soil units/assocations of the study area appear in Table 6.

[2] Includes Engelmann × white spruce hybrids.

[3] Due to inconsistencies in the literature regarding taxonomic treatment of *Abies balsamea* and *Abies lasiocarpa* (Boivin 1959, Hunt and von Rudloff 1979, and Parker et al. 1981) and to difficulties experienced in consistently recognizing the two taxa in the field, this report does not distinguish between them.

achieved by root suckering from cut trees adjacent to uncut trees, without additional silvicultural input.

iv) *Balsam and subalpine fir*—These generally regenerate satisfactorily naturally under the canopy of other trees as well as in the open, particularly at higher elevations.

Direct seeding: Satisfactory stocking results from direct seeding can be expected only where there is a large amount of exposed mineral soil (40-60%), minimal vegetational competition, and enough moisture to ensure germination and seedling establishment. Timing of the seeding operation is crucial. It should be done on spring snow cover after a light snowfall (Hellum 1974). Success of direct seeding operations has been variable and generally not encouraging.

Table 13. Reforestation method[1] on cut blocks

		Reforestation options			
Site conditions	Seed availability[2]	Lodgepole pine	White spruce[3]	Black spruce	Aspen
Soil moderately well to rapidly drained, organic layer generally <10 cm, vegetation competition not usually a problem	Abundant	Natural	Natural	Natural	Natural, root suckers
	Sparse	Container, direct seed[4]	Container, direct seed	Container, direct seed	Natural, root suckers
Soil imperfectly or more poorly drained, organic layer generally >10 cm, vegetation competition often a problem	Abundant	Container, bare-root, natural	Container, bare-root, natural	Container, natural	N/A[5]
	Sparse	Bare-root, container	Bare-root, container	Container	N/A

[1] This table should be used in conjunction with Table 12 and the ecosystem association descriptions. Interpretations for reforestation methods for the soil units/associations of the study area appear in Table 6.

[2] Seed abundance is a function of slash and cone abundance plus proximity to adjacent seed-producing trees (especially important for spruce).

[3] Includes Engelmann spruce and Engelmann × white spruce hybrids.

[4] Direct seeding will have best results when 40-60% mineral soil is exposed and soil is near field capacity.

[5] N/A = Not applicable. Aspen does not occur under these conditions.

Planting containerized stock: In general, seedling survival and early growth is influenced by the volume available for root growth and development. Consequently, a seedling grown in a unit such as a Spencer-Lemaire 55 cm^3 container should generally outperform those in the standard 40 cm^3 container, particularly on sites with potential vegetation competition or snowshoe hare damage problems. It appears that on droughty sites containerized stock may be more desirable than the larger, more water-demanding bare-root stock.

Bare-root stock: Bare-root planting stock can generally gain an advantage over container stock, especially on sites with abundant vegetational competition because of its greater size, age, and more sturdy condition. This is more true with white spruce than with pine, due to the slow initial growth of the spruce.

Limitations to reforestation success

The limitations discussed here are those of the site and do not include management considerations such as stock handling or planting errors, which can be just as significant as site limitations (Froning 1972). The limitations are self-explanatory and mainly include considerations such as excess moisture, drought, steep slopes, and vegetational competition. High soil reaction (pH) is a problem on some soils of ecosystem associations in the Athabasca valley near Hinton. These are not described in this report.

Frost heave hazard

Frost heave hazard is rated for the predominant soils of the ecosystem associations on the basis of their likelihood of heaving tree seedlings upon freezing (Table 14). This rating is based primarily upon the texture of the surface soil horizons and the moisture content of the soil, reflected by its drainage class. The most susceptible soils are those in which fine-textured surface horizons have a high silt content and imperfect drainage and from which surface organic layers have been removed. Topographic situation can be an important determinant of frost heave susceptibility, with depressions being most susceptible.

Productivity of the Ecosystem Associations

Average values of gross mean annual total volume increment (MAI) and site index (SI) at 70 years of age are given for the dominant species of each ecosystem association. The values are from sample plots in natural, unmanaged stands. Site index is primarily estimated using the curves by MacLeod and Blyth (1955), although data for 137 plots in the Wapiti map area are from stem analysis (Corns 1978).

Caution is required in utilizing the productivity figures given for the ecosystem associations. These estimates should be regarded as gross first approximations, since the base data obtained from the different sources were not always obtained in identical fashions. For example, the field procedures utilized in selection of sample trees for site index were not always consistent between studies. Additionally, some of the site index measurements may have come from trees that were under competition stress for part of their life span. Errors caused by the above factors could not be traced or evaluated.

Likewise, the mean annual increment (MAI) values listed for ecosystem units should only be used as approximations, but they are useful in assessing the relative productivity of the ecosystem associations. Certain factors, such as stand history, will contribute to a large range of productivity values and were not considered in the studies used. A further and major source of error is that MAI was calculated by dividing total volume by average age, which will overestimate the productivity of young stands and underestimate

Table 14. Frost heave hazard[1]

Internal drainage	Texture B horizon[2]	Topographic position	Hazard[3]
Rapidly to well	S, LS, SL, SiS	Upper, crest	L
		Mid	L
		Lower, toe	M
	SC, SCL, L	Upper, crest	L
		Mid	M
		Lower, toe	M
	Si, SiL, SiC, SiCL CL, C, HC	Upper, crest	M
		Mid	M
		Lower, toe	H
Moderately well	S, LS, SL, SiS	Upper, crest	L
		Mid	L
		Lower, toe	M
	SC, SCL, L	Upper, crest	M
		Mid	M
		Lower, toe	H
	Si, SiL, SiC, SiCL CL, C, HC	Upper, crest	M
		Mid	M
		Lower, toe	H
Imperfectly to very poorly	S, LS, SL, SiS	Upper, Crest	M
		Mid	M
		Lower, toe	H
	SC, SCL, L	Upper, crest	M
		Mid	H
		Lower, toe	H
	Si, SiL, SiC, SiCL CL, C, HC	Upper, crest	H
		Mid	H
		Lower, toe	H

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[1] Hazard ratings for the soil units/associations of the study area appear in Table 6.

[2] Texture symbols are as follows: S = sand(y), L = loam(y), Si = silt(y), C = clay, and H = heavy.

[3] L = low, M = moderate, and H = high. Hazard ratings assumes exposed mineral soil.

the productivity of older stands. Much further study is required to obtain accurate estimates of the productivity of ecosystem units.

Vegetational Competition

Vegetational competition is rated according to type (predominant species or species groups) and severity, with respect to its influence upon young tree seedlings (Table 15). Competition occurs for light, nutrients, water, and space.

Types of vegetational competition include that by reedgrass (primarily *Calamagrostis canadensis*), sedge (*Carex* spp.), ryegrass (*Elymus innovatus*), green alder (*Alnus crispa*), willow (*Salix* spp.), bracted honeysuckle (*Lonicera involucrata*), and forbs (especially those with large amounts of biomass and dense roots and rhizomes, including *Mertensia paniculata, Aralia nudicaulis, Aster conspicuus,* and *Epilobium angustifolium*).

Within the study area, *Calamagrostis canadensis* is the most serious competitor with conifer seedlings. It can form a dense sod that can influence soil moisture and nutrient regimes and the rooting abilities of tree seedlings. Seedlings can also be greatly shaded by the dense grass cover, and they can be pushed down by the grass when it is laid down by heavy snow, wind, or rain. *Calamagrostis* is most abundant on moist, fine-textured soils over a wide elevational range and appears to be most prevalent in the eastern portions of the study area. The other species mentioned also seem to be most competitive on moist, fine-textured, nutritionally rich soils at lower elevations. Vegetation competition seems to be less abundant on the more acidic, nutritionally poorer sites, even when they are moist. Thus the occurrence of a particular ecosystem association on soils favoring understory vegetation growth would result in a high rating for vegetation competition.

Windthrow Hazard

Windthrow hazard ratings reflect characteristics of the predominant soils occurring as part of the ecosystem associations described (Table 16). These characteristics affect development of tree roots and hence the risk of trees being blown over by normal winds. The ratings of **low, moderate**, and **high** are estimated from knowledge of root development under varying soil conditions and from field observations (Twardy and Corns 1980). It appears that trees are most subject to windthrow on soils having thick organic surface horizons that are affected by high water tables or on lithic soils having thin soils over consolidated bedrock. Windthrow is most often a problem on Organic and Gleysolic soils, but when rating specific sites, exposure and occurrence of winds of high velocity should be considered as additional factors. It was not possible to consider these latter factors in the present general rating.

Snowshoe Hare Damage Hazard

The potential for seedling browsing by snowshoe hares

Table 15. Vegetational competition hazard[1]

Internal drainage	Texture B horizon[2]	Elevation (m)	Hazard[3]
Rapidly to well	S, LS, SL, SiS	<1000	L
		1000-1200	L
		>1200	L
	SC, SCL, L	<1000	M
		1000-1200	L
		>1200	L
	Si, SiL, SiC, SiCL CL, C, HC	<1000	M
		1000-1200	M
		>1200	L
Moderately well	S, LS, SL, SiS	<1000	M
		1000-1200	L
		>1200	L
	SC, SCL, L	<1000	M
		1000-1200	M
		>1200	L
	Si, SiL, SiC, SiCL CL, C, HC	<1000	H
		1000-1200	M
		>1200	L
Imperfectly to very poorly	S, LS, SL, SiS	<1000	M
		1000-1200	M
		>1200	L
	SC, SCL, L	<1000	H
		1000-1200	H
		>1200	M
	Si, SiL, SiC, SiCL CL, C, HC	<1000	H
		1000-1200	H
		>1200	M

[1] Hazard ratings for the soil units/associations of the study area appear in Table 6.

[2] Texture symbols are as follows: S = sand(y), L = loam(y), Si = silt(y), C = clay, and H = heavy.

[3] L = low, M = moderate, and H = high.

Table 16. Windthrow hazard[1]

Internal drainage	Oraganic layer thickness (cm)	Exposure to strong wind	Hazard[2]
Rapidly to well	<10	Slight	L
		Moderate	L
		Severe	L
	10-20	Slight	L
		Moderate	L
		Severe	M
	21-30	Slight	L
		Moderate	M
		Severe	M
Moderately well	<10	Slight	L
		Moderate	L
		Severe	M
	10-20	Slight	M
		Moderate	M
		Severe	H
	21-30	Slight	L
		Moderate	M
		Severe	H
Imperfectly to very poorly	<10	Slight	M
		Moderate	M
		Severe	H
	10-20	Slight	M
		Moderate	H
		Severe	H
	21-30	Slight	M
		Moderate	H
		Severe	H

[1] Hazard ratings for soil units/associations of the study area appear in Table 6.

[2] L = low, M = moderate, and H = high.

(Table 17) and other rodents is dependent upon the presence of suitable habitat. Preferred habitat for snowshoe hares (the species causing most damage) is low, dense, woody vegetation (Buehler and Keith 1982, Keith 1966) and heavy slash that provides food and cover from predators. In the study area, such habitat is most plentiful in the Boreal Mixedwood Ecoregion and Lower Boreal Cordilleran Ecoregion at elevations below 1100 m, particularly on moist sites. The snowshoe hare damage hazard is based upon the presence of dense, deciduous, shrubby understories in the ecosystem associations described. The ratings are relative and are given for near peaks in the population cycle in years of very high hare abundance. Other species groups responsible for girdling damage to young conifers include squirrel, mouse, vole, and porcupine.

Table 17. Snowshoe hare damage hazard[1] on regenerating cut blocks

Abundance of low, dense, woody vegetation (%)	Slash abundance	Elevation (m)	Hazard[2]
<20	Low	<1100	L
		1100-1200	L
		>1200	L
	Moderate	<1100	M
		1100-1200	L
		>1200	L
	High	<1100	M
		1100-1200	M
		>1200	L
20-40	Low	<1100	M
		1100-1200	L
		>1200	L
	Moderate	<1100	M
		1100-1200	M
		>1200	L
	High	<1100	H
		1100-1200	M
		>1200	M
>40	Low	<1100	M
		1100-1200	M
		>1200	L
	Moderate	<1100	H
		1100-1200	H
		>1200	M
	High	<1100	H
		1100-1200	H
		>1200	M

[1] Hazard ratings for the soil units/associations of the study area appear in Table 6.

[2] L = low, M = moderate, and H = high.

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GLOSSARY

Alluvial (alluvium): Unconsolidated materials of variable texture deposited during comparatively recent geologic time by a stream or other body of running water.

Aspect: A measure of the orientation of a slope, expressed as a compass direction.

Base status: The relative amounts of exchangeable bases (calcium, magnesium, potassium, sodium) present in the soil. Technically, the term percentage base saturation is used. It is the percentage of the total absorption sites of the soil (cation exchange capacity) that are occupied by cations other than hydrogen and aluminum.

Bedrock: Any rock exposed at the surface of the earth or overlain by unconsolidated material.

In the field guide the bedrock geology has been grouped into four major types: volcanic, granitic, metamorphic, and sedimentary. Where more-specific ecosystem identification and interpretations are needed, more-specific bedrock types are included in parentheses in the guide.

Volcanic—Extrusive igneous; rocks exhibiting coarse grain size resulting from slow cooling under conditions of greater heat and pressure than at the earth's surface (granite, quartz-monzonite, granodiorite, quartz-diorite, diorite). These rocks do not occur in the study area.

Granitic—Intrusive igneous; rocks exhibiting coarse grain size resulting from slow cooling under conditions of temperature and pressure (rhyolite, andesite, basalt, tuff, breccia). These rocks do not occur in the study area.

Metamorphic—Rocks that have formed from previously existing rocks in response to heat, pressure, or chemical reactions causing recrystallization of rocks and materials (slate, schist, gneiss, migmatite, quartzite). Metamorphic rocks occur only in the southwest corner of the study area.

Sedimentary—Rocks that have been formed by the consolidation of materials transported and deposited by mechanical (wind, water) or chemical means (siltstone, mudstone, shale, sandstone, greywacke, conglomerates, limestone, argillite). Most rocks in the study area are sedimentary.

Biogeocoenose: The smallest ecosystem recognized in the field. Its size is limited by that of the soil polypedon and the individual uniform plant community. The biogeocoenose is a real entity occurring in nature (it has geographical bounds).

Coarse fragments: All rock fragments in soil greater than 2 mm in diameter. This includes gravels, cobbles, and stones (Canada Soil Survey Committee 1978).

Gravel—Rock fragments larger than sand and smaller than cobbles; between 2.0 and 7.5 cm in diameter, if rounded, or between 2.0 and 15.0 cm in length, if flat.

Cobbles—Rock fragments larger than gravels and smaller than stones; between 7.5 and 25.0 cm in diameter, if rounded, or between 15.0 and 38.0 cm in length, if flat.

Stones—Rock fragments larger than cobbles; greater than 25 cm, if rounded, or greater than 38 cm, if flat.

Cation exchange capacity: The sum total of exchangeable cations (positive ions such as H+, K+, Na+, Mg++, Ca++) that a soil can absorb.

Colluvial (colluvium): Materials that have reached their present position by direct, gravity-induced movement; generally associated with steep slopes.

Ecoregion: A geographical area that has a distinctive, mature ecosystem on zonal sites plus specified edaphic variation as a result of a given regional macroclimate.

Eco-subregion: A subdivision of an ecoregion that is controlled by macroclimate but exhibits less variability in soils and vegetation than does the ecoregion.

Ecosystem association: An abstract taxonomic unit above the ecosystem type. It is defined as land areas with the potential of supporting vegetation belonging to the same plant association.

Ecosystem type: An abstract taxonomic class defined as all land areas belonging to the same soil family with the potential of supporting vegetation belonging to the same plant association.

Edaphic: Pertaining to the soil.

Eolian (aeolian): Materials transported and deposited by wind action.

Facies: A form of an ecosystem association dominated by a given tree species.

Fen: Peatland comprised of neutral to acidic accumulations of organic materials mainly derived from sedges. A mineral-rich water table persists very near the surface.

Fluvial (fluvium): Materials transported and deposited by moving water (rivers and streams); synonymous with alluvial.

Fluvial fan: A fan-shaped deposit of fluvial material produced by a relatively steep gradient stream running out onto more gently sloping terrain; synonymous with alluvial fan.

Forb: Broad-leaved, nonwoody plant that dies back to the ground after each growing season. These do not include grasses and sedges.

Geomorphic: Of or pertaining to the shape of the earth or the form of its surface; resembling the earth.

Glaciofluvial: Material sorted and deposited by streams flowing from, on, or under melting glacial ice. These deposits are usually older than fluvial deposits and hence exhibit better soil development. They include outwash plains, kames, kame terraces, and eskers.

Gleying: A process of soil development occurring under conditions of poor drainage and resulting in dull greyish soil colors. The colors are the result of the reduction of iron and other compounds.

Ground moraine: Material deposited from the underside of a glacier onto the ground surface over which the glacier has moved, forming topography having a gently rolling surface (also see morainal).

Hygric (hydric): A habitat characterized by wet (hydric) or moist (hygric) conditions rather than mesic (moderate) or xeric (dry) conditions.

Lacustrine: Sediments that have settled from suspension in standing bodies of fresh water or that have accumulated at their margins through wave action.

Landform: The collective term applied to all the features that make up the earth's surface (e.g., plateau, mountain, fluvial fan, esker).

Lichen: Plant composed of an algae and a fungus growing together to their mutual benefit (symbiosis).

Meltwater channel: A bed of a stream cut by water from the melting of glacier ice. When present, the stream occupying the channel is much smaller than the channel.

Metamorphic rock: A rock formed in the solid state in response to pronounced changes of temperature, pressure, and chemical environment, which take place in the earth's interior.

Mesic: A habitat characterized by medium moisture supplies rather than hydric (wet) or xeric (dry) conditions.

Moisture regime: The relative moisture available for plant growth over the growing season. It is relative to a given regional climate as represented by ecoregions. Within an ecoregion, variation of available moisture results from redistribution of precipitation by edaphic and topographic factors.

Morainal (moraine): Material deposited directly by glacial ice. It is typically unsorted and contains a heterogeneous mixture of particles ranging from stones to clay; includes ground moraine, ablation moraine, terminal, and lateral moraines.

Moss: Small, leafy, green plants lacking any true vascular system or roots.

Nutrient regime (trophotope): The relative nutrient supply available for plant growth (with emphasis on soil pH and exhcangeable cations). It is relative to the climate conditions as represented by ecoregions.

Oligotrophic: A pond or lake that is low in basic nutritive substances for plants and lacks a distinct stratification of dissolved oxygen in summer or winter (Hanson 1962); also used on edatopic grids to describe upland sites of low nutrient status.

Outwash: Material deposited by meltwater streams beyond the glacier. The particle size may vary from boulders to silt.

Pedon: The smallest three-dimensional unit at the surface of the earth that is considered a soil. The lateral dimensions of a pedon range from 1.0 to 3.5 m on each side, depending on the variability of the soil horizons. The depth of the pedon is determined by the depth of the control section.

pH: The degree of acidity or alkalinity of a soil. In naturally occurring forest soils the pH ranges are as follows (Canada Soil Survey Committee 1978):

pH less than 5.5	Acid
pH 5.5 to 7.4	Neutral
pH greater than 7.4	Alkaline

Phase: Subdivision of a classification unit based on any criteria judged to meaningfully subdivide the unit. The phase is not a formal category in the taxonomy.

Polypedon: Consists of a group of similar contiguous pedons that are bounded on all sides by non-soils or by pedons of unlike character.

Plant association: An abstract category in vegetation classification. It is a grouping of similar plant communities.

Plant community: An area that is relatively uniform in terms of plant species composition and structural development.

Parent material: The surficial geological material (mineral or organic) from which the soil has developed; largely unaltered by pedogenic processes.

Physiographic: Pertaining to physical landform characteristics.

Physiographic subdivision: A natural region in which there are similarities in landforms resulting from similar processes of erosion and deposition, similarities of bedrock response to erosion, and similarities of mountain forming process.

Residual material: Unconsolidated or partly weathered parent material of a soil, presumed to have developed in place from the consolidated rock on which it lies.

Sedimentary rock: Rock formed by the consolidation of sediment deposited in water or by air.

Seepage: Water passing laterally and downslope through the soil; often provides a source of water and nutrients to the soil.

Shrub: Woody perennial of smaller structure than a tree. In the field guide some low shrubs (less than 15 cm) are recorded in the C layer. (See Table 4.2, pp. 141, in Walmsley et al. (1980) for a list of these species.)

Soil: The naturally occurring unconsolidated mineral or organic material at least 10 cm thick that occurs at the earth's surface and is capable of supporting plant growth (Canada Soil Survey Committee 1978). In special cases where the growing substrate does not meet the above definition of soil yet supports a plant community, the growing medium is considered to be soil.

Soil classification: In the field guide the soils have been classified at the subgroup and family levels. For more-complete explanations of soil classification terms and procedures, refer to the Canadian System of Soil Classification (Canada Soil Survey Committee 1978).

Subgroup—Subdivision of a great group. Subgroups are differentiated on the basis of the kind and arrangements of horizons within the profile.

Family—A subdivision of a subgroup on the basis of parent material characteristics such as particle size, mineralogy, soil climate factors, and soil reaction. In the field guide only the particle size criterion has been used.

Soil drainage: Rate of water removal from a soil in relation to its water supply. It is affected by a number of factors acting separately or in combination, including soil texture, slope position and gradient, and evapotranspiration (Dumanski 1978).

Soil particle size distribution: Relative proportions of the different sized soil particles. The particle size distribution of the soil's fine fraction (less than 2 mm) determines its soil texture.

Soil perviousness: The potential of a soil to allow water to pass through it. It is affected by soil texture, structure, porosity, cracks and shrink-swell properties.

Solum: The upper horizons of a soil in which the parent material has been modified and in which most plant roots are contained. It usually consists of A and B horizons.

Surficial geology: The geology of surface deposits, especially unconsolidated residual, fluvial, or glacial deposits lying on top of bedrock.

Topoedaphic: Pertaining to both soil and topographic position.

Vegetation layers (strata)—Based on the life form and normal height of plant species. These layers are used as aids in describing the appearance of the vegetation components of ecosystems. The following classes are used.

Tree layer— All woody plants greater than 5 m tall.

Shrub layer— All woody plants less than 5 m tall and generally greater than 15 cm tall. It includes tree regeneration.

***Herb layer*—** All herbaceous plants (forbs and grass-like plants) regardless of height as well as some low woody plants (generally less than 15 cm tall).

***Moss layer*—** All mosses, liverworts, lichens, bryophytes, and tree seedlings less than 2 years old.

Veneer: With reference to parent materials, a veneer is a deposit of materials too thin to mask the minor irregularities of the underlying materials. It is 1 m or less in thickness.

Xeric: A habitat characterized by dry conditions rather than mesic (moderate) or hydric (wet) conditions.

Zonal sites: Sites that will support ecosystems that best reflect the regional climate of an area. They have relatively deep soil parent materials (mineral or organic) on which soil-forming processes have been active for a long period of time, resulting in well-developed soil profiles. They are intermediate in moisture regime for the climate in which they occur and are intermediate in nutrient regime.

Zonal ecosystem: A biogeocoenose whose site is zonal. A mature or well-developed zonal biogeocoenose is used as the reference ecosystem in the definition and delineation of zones.

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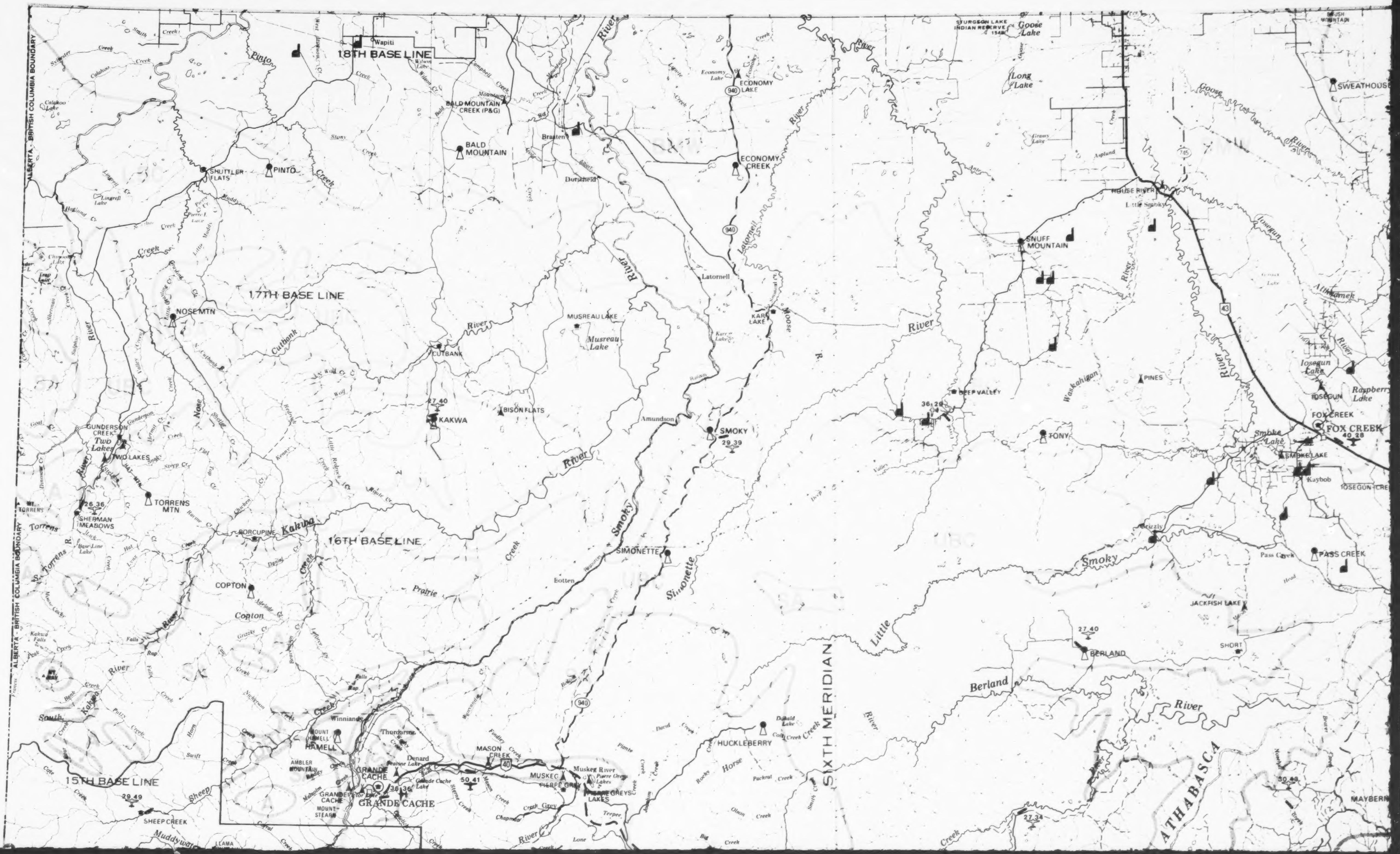
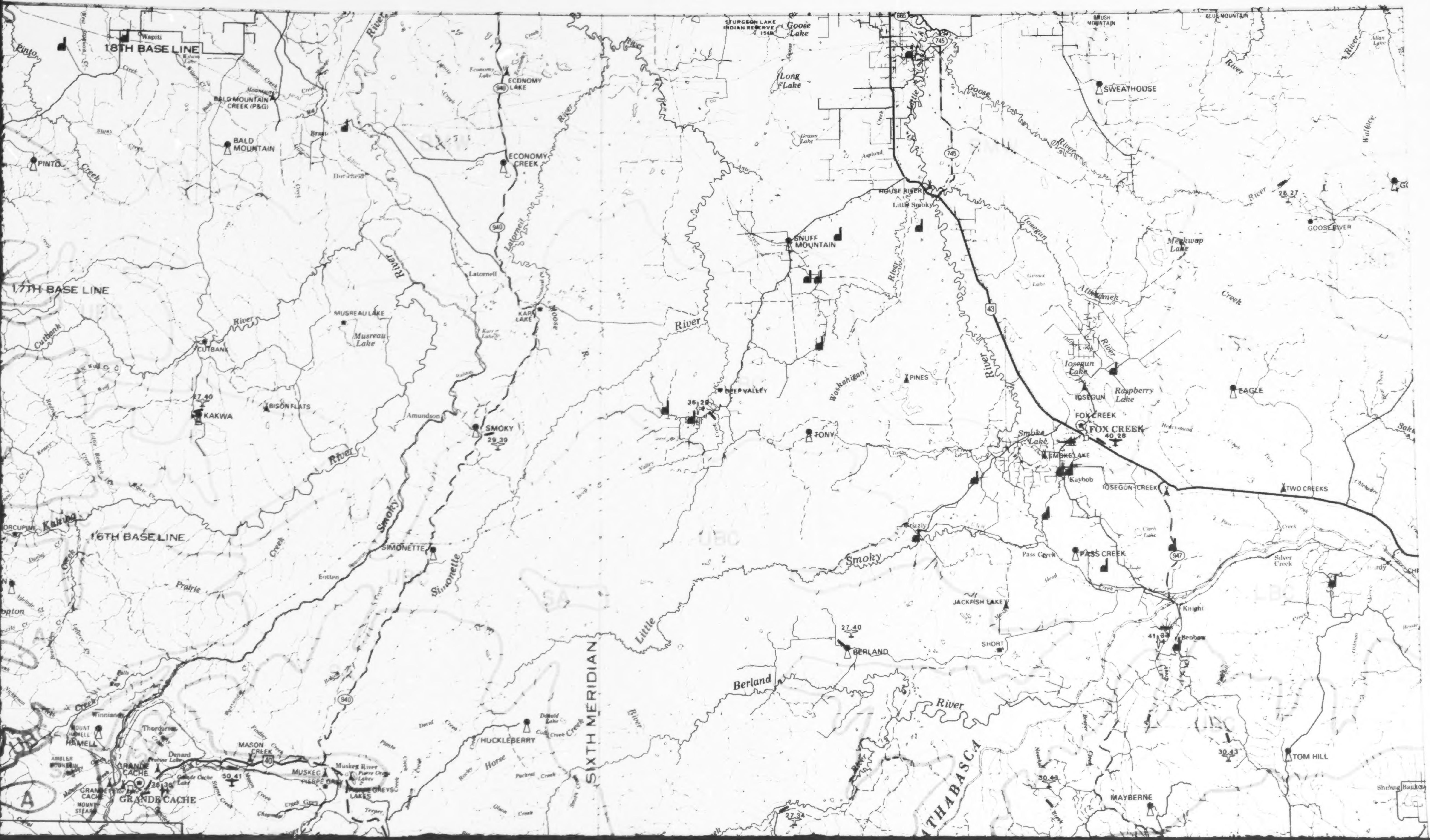
ECOREGIONS OF WEST-CENTRAL ALB A



ALBERTA - BRITISH COLUMBIA BOUNDARY
18TH BASE LINE
17TH BASE LINE
16TH BASE LINE
15TH BASE LINE
SIXTH MERIDIAN
Wapiti
BALD MOUNTAIN CREEK (P&G)
BALD MOUNTAIN
PINTO
SHUTTLER FLATS
Braaten
Dunvegan
ECONOMY LAKE
ECONOMY CREEK
Economy Lake
STURGEON LAKE INDIAN RESERVE 154B
Goose Lake
Long Lake
SWEATHOUSE
BRUSH MOUNTAIN
HOUSE RIVER
Little Smoky
SNUFF MOUNTAIN
Latornell
KARR LAKE
MUSREAU LAKE
Musreau Lake
NOSE MTN
CUTBANK
KAKWA
27.40
BISON FLATS
Amundson
SMOKY
29.39
DEEP VALLEY
36.29
PINES
TONY
Iosegun Lake
IOSEGUN
Raspberry Lake
FOX CREEK
40.28
Smoky Lake
SMOKE LAKE
Kaybob
IOSEGUN CREEK
GUNDERSON CREEK
Two Lakes
TWO LAKES
TORRENS MTN
TORRENS
26.36
SHERMAN MEADOWS
PORCUPINE
Kakwa
SIMONETTE
COPTON
Copton
Botten
Grizzly
PASS CREEK
Pass Creek
JACKFISH LAKE
BERLAND
SHORT
MOUNT HAMELL
HAMELL
Winniandy
Thurdarson
Denard
MASON CREEK
50.41
GRANDE CACHE
36.36
MOUNT STEARN
AMBLER MOUNTAIN
MUSKEG
Muskeg River
PIERRE GREYS LAKES
HUCKLEBERRY
Donald Lake
29.49
SHEEP CREEK
LLAMA
27.34
50.40
MAYBERRY
ATHABASCA
940
40
43
Smoky River
Little Smoky River
Berland River
Simonette
Waskahigan
Cutbank River
Kakwa River
Prairie Creek
Sheep
Muddywater
Grey
Teepee
RMW
LBC
UBC
SA

ECOREGIONS OF WEST-CENTRAL ALBERTA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Pinto
PINTO
BALD MOUNTAIN CREEK (P&G)
BALD MOUNTAIN
ECONOMY LAKE
ECONOMY CREEK
Economy Lake
STURGEON LAKE INDIAN RESERVE 154B
Goose Lake
Long Lake
Grassy Lake
Asplund
HOUSE RIVER
Little Smoky
SWEATHOUSE
BRUSH MOUNTAIN
BLUE MOUNTAIN
Goose River
GOOSE RIVER
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17TH BASE LINE
Cutbank River
CUTBANK
MUSREAU LAKE
Musreau Lake
Latornell
KARR LAKE
Moose R.
SNUFF MOUNTAIN
River
Waskahigan
PINES
Iosegun
Iosegun Lake
Raspberry Lake
IOSEGUN
Atikkamek Creek
Meekwap Lake
EAGLE
FOX CREEK
40 28
Smoke Lake
SMOKE LAKE
Kaybob
IOSEGUN CREEK
TWO CREEKS
47 40
KAKWA
BISON FLATS
DEEP VALLEY
36 29
TONY
Amundson
SMOKY
29 39
Smoky River
16TH BASE LINE
PORCUPINE
Kakwa
Prairie Creek
SIMONETTE
Simonette
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Grizzly
Smoky
PASS CREEK
Pass Creek
Silver Creek
Knight
JACKFISH LAKE
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BERLAND
Berland River
41 39
Benbow
Little Smoky
SIXTH MERIDIAN
HUCKLEBERRY
Donald Lake
Findley Creek
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Winniandy
MOUNT HAMELL
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Denard
AMBLER MOUNTAIN
GRANDE CACHE
GRANDE CACHE
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MUSKEG
Muskeg River
PIERRE GREYS LAKES
Pierre Greys Lakes
27 34
THABASCA
30 43
30 43
TOM HILL
MAYBERNE
Shining Bank
SMW
UBC
LBC
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745
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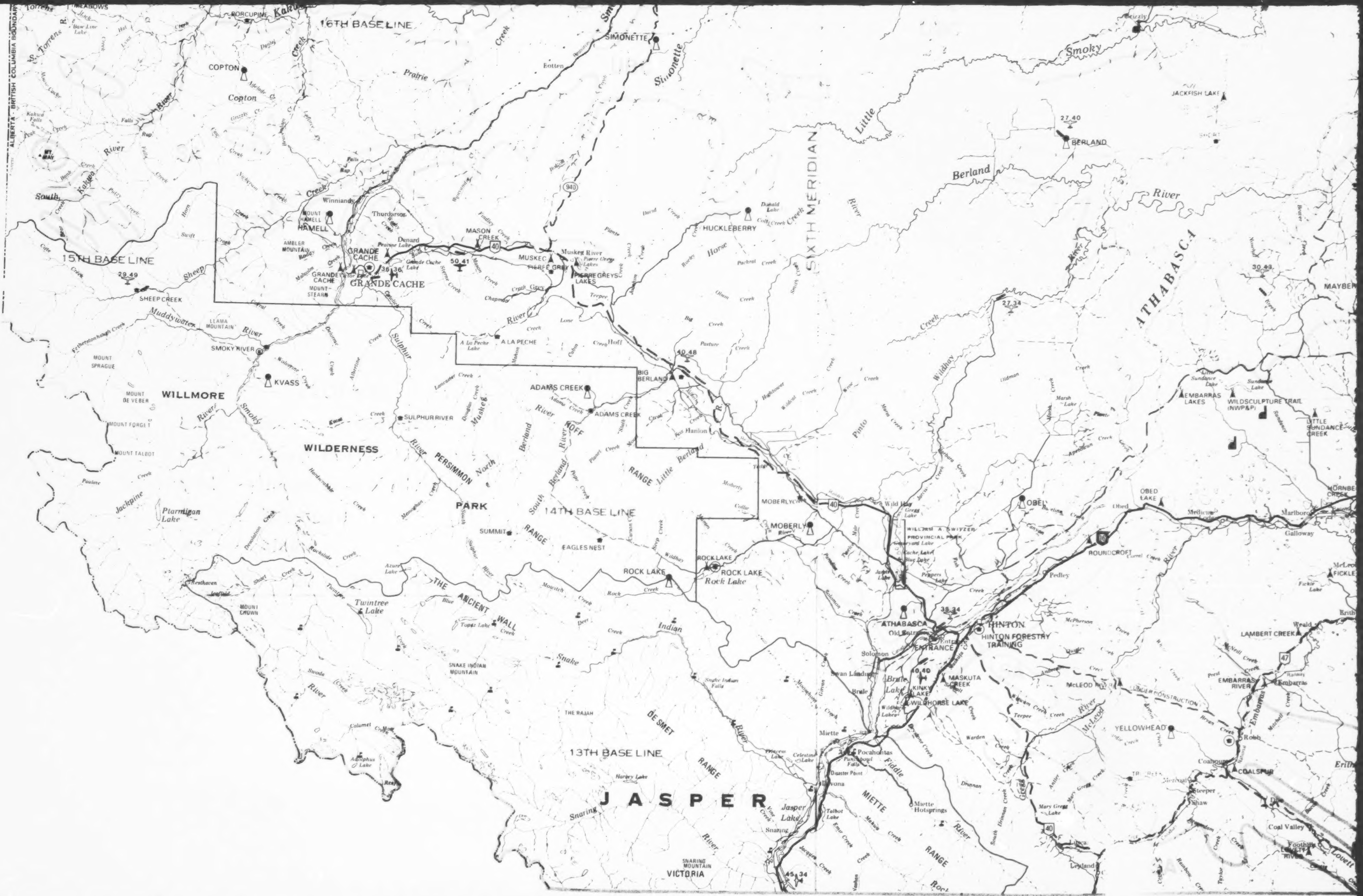
ALBERTA - BRITISH COLUMBIA BOUNDARY
16TH BASE LINE
15TH BASE LINE
14TH BASE LINE
13TH BASE LINE
SIXTH MERIDIAN
WILLMORE
WILDERNESS
PARK
JASPER
ATHABASCA
PERSIMMON
RANGE
THE ANCIENT WALL
DE SMET
RANGE
MIETTE
RANGE
PORCUPINE
COPTON
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SIMONETTE
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Eotten
Prairie
Smoky
Kakwa
River
South
Sheep
SHEEP CREEK
29.49
Muddywater
LLAMA MOUNTAIN
SMOKY RIVER
KVASS
MOUNT SPRAGUE
MOUNT DE VEBER
MOUNT FORGET
MOUNT TALBOT
Jackpine
Ptarmigan Lake
Winniandy
MOUNT HAMELL
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AMBLER MOUNTAIN
GRANDE CACHE
GRANDE CACHE
MOUNT STEARN
Grande Cache Lake
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MASON CREEK
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MUSKEG
Muskeg River
PIERRE GREY
PIERRE GREYS LAKES
Chapman
Grey
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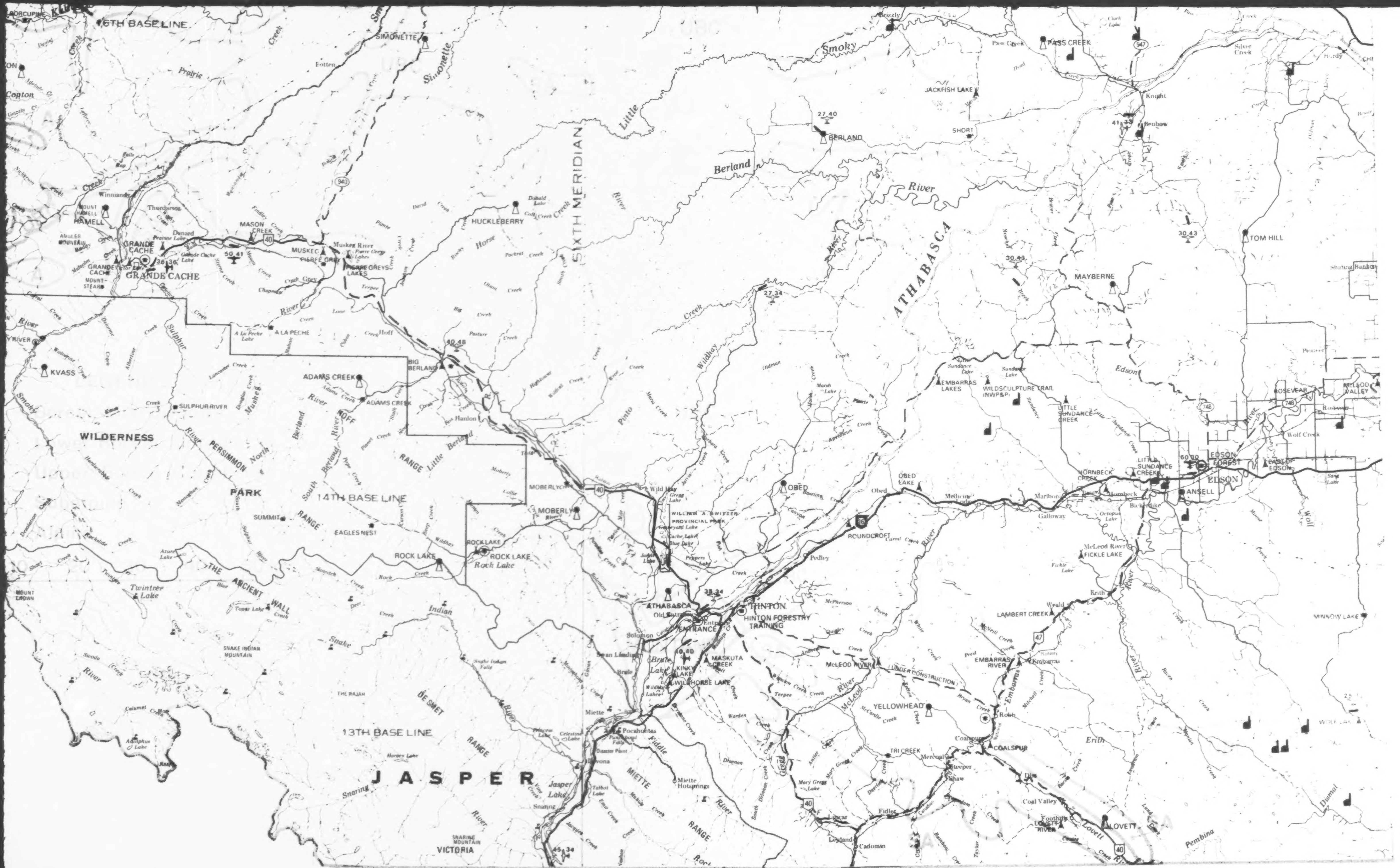
A LA PECHE
A La Peche Lake
Lone
Cabin
Hoff
HUCKLEBERRY
Donald Lake
Horse
Pachrat
Big
Pasture
40.48
BIG BERLAND
ADAMS CREEK
ADAMS CREEK
SULPHUR RIVER
Sulphur
Muskeg
North
Berland
South Berland
Little Berland
Hanlon
SUMMIT
EAGLES NEST
ROCK LAKE
ROCK LAKE
Rock Lake
Wildhay
MOBERLY
MOBERLY
Azure Lake
Twintree Lake
MOUNT CROWN
Topaz Lake
SNAKE INDIAN MOUNTAIN
Snake
Indian
Snake Indian Falls
THE RAJAH
Harvey Lake
Snaring
Jasper Lake
Talbot Lake
VICTORIA
SNARING MOUNTAIN
45.34
Miette
Pocahontas
Punchbowl Falls
Disaster Point
Fiddle
Miette Hotsprings
Brule
Brule Lake
Swan Landing
Solomon
ATHABASCA
ENTRANCE
HINTON
HINTON FORESTRY TRAINING
35.34
40.40
KINKY LAKE
MASKUTA CREEK
WILDHORSE LAKE
WILLIAM A. SWITZER PROVINCIAL PARK
Jarvis
Gregg Lake
Wild Hay
Pinto
Little
Berland
River
Jackfish Lake
27.40
BERLAND
27.34
30.49
OBED
OBED LAKE
Obed
ROUNDCROFT
16
Pedley
McPherson
McLeod
McLEOD RIVER
YELLOWHEAD
Mary Gregg Lake
Leyland
40
EMBARRAS LAKES
WILDSCULPTURE TRAIL (NWP&P)
LITTLE SUNDANCE CREEK
Sundance
Marlboro
Galloway
Fickle
LAMBERT CREEK
47
EMBARRAS RIVER
Embarras
Robb
Coalspur
Steeper
Shaw
Coal Valley
LOVETT RIVER
Lovett
Erith
MAYBER



16TH BASE LINE
SIMONETTE
Smoky
Grizzly
PASS CREEK
Pass Creek
JACKFISH LAKE
947
Knight
Benbow
Hardy
Silver Creek
Porcupine River
Prairie Creek
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Little Smoky
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PIERRE GREYS LAKES
HUCKLEBERRY
Dubald Lake
Rocky Horse Creek
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A LA PECHE
A La Peche Lake
40.48
BIG BERLAND
Hoff
Pass Hanlon
Wildhay
Pinto
Creek
Embarras
Sundance Lake
EMBARRAS LAKES
WILDSCULPTURE TRAIL (NWP&P)
LITTLE SUNDANCE CREEK
Edson
748
ROSEVEAR
McLEOD VALLEY
Wolf Creek
EAST OF EDSON
EDSON FOREST
EDSON
60.90
LITTLE SUNDANCE CREEK
HORNBECK CREEK
Hornbeck
ANSELL
Marlboro
Galloway
Bickerdike
Medicine Lodge
OBED LAKE
Obed
OBED
16
ROUNDCROFT
Pedley
KVASS
SULPHUR RIVER
ADAMS CREEK
ADAMS CREEK
Smoky
WILDERNESS
PERSIMMON
North
PARK
RANGE
South Berland
Little Berland
14TH BASE LINE
SUMMIT
EAGLES NEST
MOBERLY
MOBERLY
Wild Hay
Gregg Lake
WILLIAM A. SWITZER PROVINCIAL PARK
Graveyard Lake
Cache Lake
Blue Lake
Jarvis Lake
Peppers Lake
ROCK LAKE
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McLEOD RIVER
UNDER CONSTRUCTION
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Fickle Lake
McLeod River
FICKLE LAKE
LAMBERT CREEK
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EMBARRAS RIVER
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COALSPUR
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Calumet Creek
Adolphus Lake
Swoda Creek
Teepee
Warden
Dunnan
Gregg
TRI CREEK
Mercoal
Steeper
Shaw
Mary Gregg Lake
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Luscar
Fidler
Leyland
Cadomin
Coal Valley
Foothills
LOVETT RIVER
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Dismal